

disciplines of embryology and anatomy demand. The way is long and tedious, but the scientific footing is solid.

ARNOLD GESELL,
Director

THE YALE CLINIC OF
CHILD DEVELOPMENT

THE ORIGIN OF NATURAL OIL

THE writer of this article is compelled to adhere to his view expressed in *SCIENCE* of September 7, and questioned by Professor J. M. Macfarlane in the issue for November 23. The reasons are to be found in chemical and geochemical considerations. The specialist in the field of bituminous coal, natural asphalt and oil is struck with the relation of these substances. They consist of aliphatic, semi-aromatic and aromatic compounds. The presence of bituminous coal and oil in the same localities, but in different strata, for instance, near Pittsburgh, forces one to the point of view that both substances were formed from the same original material. If this point of view and the fish theory are correct, the origin of bituminous coal and oil would have to be traced back to dead fish. Probably few adherents will be found for such a theory.

The chemical world to-day rejects almost entirely the fish theory. Investigations by P. D. Trask and C. C. Wu¹ have shown that on distillation of samples of sea and lake water muds, which probably contain the remainder of dead fish, oil-like substances can scarcely be obtained. The quantity of oil received therefrom was exceedingly small.

Investigations have shown that under geochemical conditions the teeth and bones of fish remain almost intact. In rocks containing oil fewer inorganic relics of fish are found than undamaged parts of cellulose and wood.

The so-called catastrophe theory has been invented to save the fish theory. The entrance of fresh water into sea water or sea water into fresh water is supposed to have led to the death of enormous quantities of fish. Professor Macfarlane believes volcanic and seismic causes are responsible for this. It is difficult to explain from such a point of view the presence of oil in different strata above each other. Such would mean that catastrophes occurred at the same place at several different times.

Carbohydrates are produced by nature in the greatest degree; probably even more so in earlier periods. The quantity of fish compared to this is small. The presence of enormous quantities of oil in the interior of the earth is therefore contrary to the fish theory. It is more than probable that the savings buried by nature in the form of coal and oil in the earth origi-

nate principally in the enormous quantities of carbohydrates and carbohydrate-humic acids transformed therefrom (not lignin-humic acids) and very little, if any at all from fish.

The question of the origin of oil and bituminous coal may be clarified only by experiments and observation of thermo-dynamic, geological and geochemical conditions. The carrying out of experiments should take place under geochemical conditions. In this respect, the writer of this article has to criticize the otherwise valuable experiments carried out by Warren and Storer.² Warren and Storer decomposed at "red hot heat" the lime soap which was produced on saponification of fish oil with strong excess of lime. All those who have been engaged with research work on the origin of oil know that neither the action of strong hydrate of lime nor such high temperatures were possible during the formation of oil. At the low temperatures which must be considered here, the lime soap would have to be stable. In any case, it would not lead to the formation of aromatics, such as has been observed in crude oil. From a thermodynamic view-point, the transformation of aliphatic hydrocarbons formed from aliphatic acids into ring hydrocarbons is not possible at lower temperatures. The temperatures required for such transformation are above the temperature for the formation of crude oil, which certainly has not gone beyond 300° C. One can find derivatives of chlorophyll in all crude oils and asphalts. These substances are completely destroyed at temperatures above 300°.

For the formation of aromatic compounds, therefore, other reactions must be responsible. Carbohydrates may be transformed at comparatively low temperatures into semi-aromatics and aromatics (phenols and phenolcarboxylic acids). By such reactions the presence of aromatics and naphthenes in crude oil is not difficult to explain.

On the basis of his own experiments and because of thermodynamic, geological and geochemical facts, which are contrary to the fish theory, the writer of this article can not adhere to the truth of the aphorism that "fish is the source of petroleum." His experimental work and that of his collaborators in this regard will be published elsewhere.

E. BERL

CHEMICAL RESEARCH LABORATORY
CARNEGIE INSTITUTE OF TECHNOLOGY

LUNAR RINGS

ON the evening of November 22, 1934, San Franciscans were treated to a display of spectral rings about the moon. It was first noticed by us from the steps of the Academy of Sciences at 10 P. M.,

¹ *Bull. Am. Ass. Petrol. Geol.*, No. 11, 1928, and 1451, 1930.

² "Amer. Acad. Arts and Sc. Memoirs," S2, 9, page 177, 1867.

but residents had been observing it for an hour or more. The moon was full and high overhead. Fleecy streaks of cloud, commonly termed "high fog," much too thin to obscure the disk, drifted slowly across; these seemed to be the cause of the unusual phenomenon. When we first saw it there was an inner circle, about six moon-diameters, bright, opalescent white, followed by the spectral rings from red to violet. The total diameter of the violet ring was about 12 moon diameters. Each color was sharply separated from its neighbors and the whole formed a magnificent and brilliant exhibit of the spectrum. The intensity and purity of the colors seemed to be much more pronounced than is usually seen in solar rainbows.

Points of visibility were somewhat localized. On

Geary Street, five blocks away, the rings were gone and the moon was surrounded only by the opalescent disk, fading gradually outwardly. A few minutes later, at the academy, the spectral band was even more brilliant and sharply defined than when first observed, due apparently to its having shrunk to about half its former diameter. Six blocks away a few minutes later it had disappeared.

The variation in size was doubtless the result of the difference in elevation of the cloud. A slight tendency to become oval in shape was noticed occasionally, and this was probably also caused by variable thickness and elevation of the refractive stratum.

G. D. HANNA
W. M. GRANT

CALIFORNIA ACADEMY OF SCIENCES

SCIENTIFIC BOOKS

THE STORY OF A MIND

Franklin Paine Mall, The Story of a Mind. By FLOR-
ENCE RENA SABIN, M.D., Member of the Rockefeller
Institute for Medical Research. The Johns Hop-
kins Press, pp. i-xiii, 1-342. \$2.75.

HERE is the fascinating story of the life and work of one of the outstanding figures in the promotion of research in anatomy and embryology and in the reorganization of medical education in the United States. From a farm in Iowa and from a village school, Franklin Paine Mall, of German blood from both parents, went to the Medical Department of the University of Michigan in 1880 and in 1883, at the age of 26, was graduated with the degree of M.D. Stimulated by an inner drive for more knowledge he went to Germany without any very definite plan; but, with the thought that he wanted to know more about ophthalmology, he spent the academic year of 1883-84 at Heidelberg University and at the end of that year, realizing that his interests were chiefly in anatomy and embryology, he went to Leipzig and sought and obtained the privilege of working under the foremost authority in the world on those subjects, Wilhelm His. Here he learned the latest methods of research in embryology and, still more important, the value of exact methods in scientific research. A research topic was assigned him and he was encouraged to work independently, and the independence and thoroughness of his work were demonstrated by the fact that in this, his first research, he reached conclusions at variance with those of his revered professor, who subsequently acknowledged his own mistake and for the remainder of his life remained a devoted friend of Mall.

A third year in Germany he spent in the laboratory of the distinguished physiologist, Carl Ludwig, in Leipzig, and it is no exaggeration to say that Ludwig

then and ever after treated him as a beloved son. He not only suggested an important problem of research and gave constant encouragement and frequent advice, but when the results of this and of later researches were submitted to him for publication, he edited them and even had the illustrations redrawn—and all with a delicacy of suggestion and a pride in the work of his young friend which was certainly most unusual and which indicated that he recognized in Mall a person of extraordinary ability and promise. When Mall expressed his great obligations and asked how he could ever repay them, he was told merely, "Pass it on!"

This ideal association with Ludwig was probably the most potent factor in shaping Mall's career, and in after years his aid and encouragement to those who did research work in his laboratory, and the love and admiration which they had for him, are evidences that he followed Ludwig's admonition to "pass it on."

On his return to the United States, Mall sought and obtained a fellowship at the Johns Hopkins University under Dr. Welch, whom he had met in Ludwig's laboratory and who ever after remained his great friend and admirer. This fellowship in pathology he held from 1886 to 1889. From 1889 to 1892 he was adjunct professor of anatomy in Clark University, and on the organization of the new University of Chicago he joined or rather led the migration from Clark to Chicago, where for a single year 1892-93, he was professor of anatomy in the Division of the Biological Sciences. He then yielded to the persuasions of Dr. Welch to accept the chair of anatomy in the newly organized Department of Medicine at the Johns Hopkins University, and this position he held until his death in 1917.

This bare outline of Dr. Mall's university connec-