

PROFESSOR BIRBAL SAHNI'S CONTRIBUTIONS TO INDIAN GEOLOGY

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FOR more than three decades, since the completion of Feistmantel's classic work on the Indian Gondwana flora in 1886, the study of fossil plants had suffered a serious set-back as Indian geologists were sceptical regarding their value in geological chronology. Geologists were largely influenced by the attitude which W. T. Blandford took up in 1876 that the evidence founded upon fossil plants should be received with caution, and that such evidence was in some cases opposed to the evidence furnished by marine faunas. The year 1920, in which Seward and Sahni's volume on the revision of Indian Gondwana plants appeared, is a landmark in the history of Indian geology and palaeobotany: this year marks the revival of palaeobotanical research in India with plant fossils coming more and more into the picture of Indian geology. Prof. Sahni was a rare combination of the botanist and the geologist and the unique position he held in both the sciences made him eminently suited to bridge the gulf that separated them. He did more than anyone else to convince the geologist that study of plant fossils yielded results of a far-reaching nature which the geologist could not afford to ignore.

To Prof. Sahni plant fossils were not just chance relics of ancient floras; they had a deeper significance to him. Their geological background and implications were always present in his mind. His work, at every stage, impinged upon the domain of geology, and the field of palaeobotany became a meeting ground for botanists and geologists in this country. In a memorable address delivered to geologists in 1926, he expressed that fossil plants represent the debt that botany owes to geology. In return, palaeobotanical research which he initiated has not only been helpful in solving stratigraphical problems, but has also thrown light upon questions of palaeogeography, past climates and even earth movements. At the same time it has made its contributions to economic geology.

It is difficult to give an adequate idea, within the space of a brief article, of the extent to which he influenced geological thought and research in India within the last two decades and more. It was in this country that the first *Glossopteris* was discovered and the great problems in geology concerning the Gondwanaland were raised and discussed. The Gondwana problems naturally attracted a good deal of his attention. Two other chapters of Indian geology where his researches had their repercussions were the Deccan Traps and the Punjab Saline Series. He realized the importance of micropalaeontology, both in its academic and applied aspects, and the micropalaeontological technique which he had already employed in his work on the Saline Series was extended to other problems: in elucidating the Tertiary sequence of Assam and as an aid to the measurement of geological time in India.

Few problems in Indian geology have aroused greater controversy than those connected with the classification and age limits of the Gondwana formations. Feistmantel's original classification into Upper, Middle (with Parsora stage as a transitional stage) and Lower has been questioned by later geologists, particularly Cotter and Fox. Fox thought there was no justification for Middle Gondwanas as there was a floral break above the Panchet stage. He further included the Parsora stage in the Jurassic. Prof. Sahni, however, did not agree that the Parsora flora was Jurassic and, on the other hand, he thought it was not younger than the Trias and possibly as old as the Permian. The geologists, again, considered the upper age limit of the Gondwanas as Lower Cretaceous, as Lower Cretaceous ammonites are found associated with the east-coast Gondwanas. In this connection the silicified flora of the Rajmahals received a good deal of attention from Prof. Sahni. Feistmantel's account of this flora was mostly confined to leaf impressions and in recent years many fossil-bearing localities had been discovered.

From a critical examination of the petrifications, Prof. Sahni came to the conclusion that the flora was Jurassic with not a single species characteristic of the Cretaceous.

A problem in which he took a great interest for many years was that of continental drift. Whereas Wegener thought that continents had broken up by drifting apart, Prof. Sahni, on palaeobotanical evidence, elaborated a complementary theory that continents once separated by oceans had drifted towards each other.

In 1934 his first contribution on the silicified flora of the Deccan Intertrappean beds appeared, and with this was revived a geological controversy which dates back to the time of the pioneer geologists Hislop and Hunter. As against the Cretaceous age put forward on geological grounds by Blanford and others, Prof. Sahni found that the flora was distinctly Eocene, and it is gratifying to note that the Eocene view later received its strongest support from the geologists themselves.

For more than sixty years, the age of the Saline Series had been a baffling problem to Indian geologists and the way in which Prof. Sahni was attracted to this problem may be stated in his own words (1947)¹: "About four years ago, while with a party of students in the Salt Mine at Khewra, it occurred to the author to dissolve a little of the saline earth and to examine some drops of the brine under the microscope. The idea was that since the salt must have been formed from sea-water by the drying up of a bay or lagoon, the brine ought to show at least some minute traces of organic remains which might give a clue to its geological age. The surmise proved to be correct: quite a number of little shreds of woody tissue of dicotyledons and conifers, as well as the chitinous remains of winged insects, were discovered. These fragments had no doubt been washed into the water or wafted on to its surface by the wind; and it was clear that *if these creatures were alive at the time the sea existed, the salt could not possibly be so old as the Cambrian.*" This view necessitated the introduction of an overthrust between the Saline Series and the overlying Cambrian beds. Dr. Gee and other field geologists, however, maintain that the Saline Series of the Salt Range is in its normal stratigraphical

sequence and, therefore, Pre-Cambrian in age. The critical evidence proving the Saline Series to be the lowest exposed member of the Salt Range Cambrian is the nature of the junction of the series and the overlying Cambrian beds. This junction, according to Dr. Gee, is an undisturbed sedimentary one and the problem, therefore, is to discover how Prof. Sahni's microfossils were introduced into the Cambrian sequence. To Dr. Gee's arguments, Prof. Sahni replied (1947)²: "Enough has been said to show that the field criteria upon which reliance is placed by the geologists of the Cambrian school are not safe criteria. The Salt Range question which has so long baffled us is no longer a problem of local significance: we must learn to judge it by standards based upon wider experience... Between the testimony of the rocks and the testimony of the fossils there can be no real conflict. When the two do not seem to agree, it is the direct evidence of the fossils that is to be relied upon: palaeontology is a surer foundation for stratigraphy than field evidence."

One aspect of geology in which he was particularly interested in later years was micropalaeontology regarding which he states³: "The last few decades have seen the rise of micropalaeontology to a position of considerable importance in geology, particularly in the quest for oil. Although it was the academic geologists who first realized the scientific value of microfossils, we owe the main developments in this field to the applied geologists, and particularly to the palaeontologists employed in the oil and coal industries." Regarding further applications of this branch of study, he writes⁴: "We now know that not all sedimentary formations which outwardly appeared to be unfossiliferous are really devoid of organic remains. Some of these have recently been shown to be astonishingly rich in microfossils representing both plant and animal groups. The Saline Series in the Salt Range of the Punjab is a good case in point, so also the glacial tillites at the base of the Gondwana system in Australia and South Africa — and quite recently organic remains have also been detected in the Talchir Boulder Bed near Chittidil in the Salt Range. Owing to their wide dissemination in the

2. *Proc. Nat. Acad. Sci. India*. Opening Address, pp. xlv, xlvi. 1947.

3. *Nature*. 160: 771, Dec. 6, 1947.

4. *Current Science*. 16: 203, July 1947.

1. Kashi Vidyapitha Silver Jubilee Commemoration Volume, p. 17.

body of the rock-matrix microfossils can sometimes provide an age index even if small bits of the rock collected at random are analysed. . . . There are great areas in India, particularly in the Peninsula, covered by ancient sedimentary rocks of unknown or disputed age. Very few megafossils have been found in these strata, nor are we likely to find many more in the future. An attempt may usefully be made to recover microfossils from samples of these rocks which should be collected from localities and horizons by geologists who best know the areas."

His activities were, however, not confined to the laboratory; he believed that palaeobotanists should have experience of field-work and missed no opportunity of visiting fossil localities with his hammer, note-book and Leica. The Salt Range, the Rajmahal Hills and the Deccan Intertrappean areas were all familiar grounds to him. His field-notes of the Salt Range (preserved among his unpublished manuscripts) bear testimony to his keen and shrewd perception and understanding of complicated geological structures. Those who accompanied him in his geological excursions retain vivid memories of a personality full of physical and mental vigour, never sparing himself and with an unbounded enthusiasm for fossil collections and field data. A few weeks before his death he led an excursion to the Rajmahal Hills. Those who were with him can never forget the thrill and joy with which he greeted the discovery of the *Williamsonia*-bearing beds near Amarjola. Among several projects he had planned for

the Institute of Palaeobotany, mapping of the plant-beds of India held a high priority. He was also anxious to lead an expedition to the Spiti region of the Himalayas.

He took very great interest in geological research and teaching in Indian universities and it was due to his efforts that the subject was introduced in many of the universities. He was the Head of the Geology Department of the Lucknow University since its inception in 1943: his inspiring lectures on dynamical geology and palaeobotany and the singular success he achieved in stimulating and training young talent for research soon made the Department an important teaching and research centre for geology in this country.

He had close friendships and strong scientific connections with leading geologists all over the world, and no geologist from any part of the world while visiting India ever missed the opportunity of meeting Prof. Sahni in his laboratory and museum at Lucknow. The voluminous scientific correspondence he has left behind forms a very valuable record of contemporary geological thought and trends.

No notice of Prof. Sahni's work or life would be complete without a reference to his wife, Srimati Savitri Sahni, whose understanding sympathy and companionship meant everything to him. She always accompanied him on his scientific travels and took part in many of his geological excursions. Her unflinching devotion in no small measure contributed to the great scientific achievements of Prof. Sahni.