Special issue
Extinct plants, evolution
and Earth's history

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Professor Birbal Sahni—the man and his message

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'A man who pursues his work in such a devoted manner, follows the right path, his work is good, the man is good.'
—Jawaharlal Nehru

THE impression a textbook leaves in a young mind is often powerful and lasting. My introduction to Birbal Sahni was through his textbook of botany for Indian students, which was an adaptation of Lowson's textbook and appeared under the joint authorship of Lowson and Sahni. In the genre of textbooks of the time it impressed us, young learners of the thirties, as a model to be cherished.

Birbal Sahni belonged to a generation infused with the spirit of nationalism—intent on freeing India from the British—, imbued with a deep sense of dedication and moral values, and drawn to the highest ideals with visions of building up institutions in the country. Anniversaries provide us an opportunity to look at the life and work of the great. They have a special relevance to us today when dedication and passion to perform great things and a sense of values are generally on the decline.

My one great regret is that I never had an opportunity of meeting Birbal Sahni. This feeling is deepened all the more because the more I ponder over his work the deeper is the meaning and relevance that I find in it for us. 'Style is the man', wrote Matthew Arnold. Sahni's style as teacher, scientist, organizer and human being marks him as truly great. The relevance of his style to us and to future generations is as unmistakable as it is pertinent. We are amazed at the extraordinary diversity and breadth of his interests, the original and thorough nature of his work, his extensive knowledge and intellectual versatility, the range and depth of his vision and his contributions, and the magnitude of his achievements. One must ask oneself why so much was done and how so much could be achieved in a short span of about three decades by one individual, especially under the conditions that prevailed at the time. There were no funding agencies then,

Birbal Sahni with brother Mulk Raj Sahni

nor were there any to call the tune. Birbal Sahni had the freedom to work as he chose to. 'The wind bloweth where it listeth'. In the pursuit of science, freedom is of the essence for each of us.

Birbal Sahni was born on 14 November 1891 at Bhera in Punjab, the third child of Ruchi Ram Sahni and Ishwari Devi. The combination of noble parentage and good nurture at once built into Sahni many rare and desirable elements: an independent outlook, a confidence and determination to do great things, an idealism and faith in ethical values and in the spirit of Man, a sense of duty, and, equally important, a love of nature. The lofty and bounteous Himalayas were everything to him.

After education in Lahore, Sahni went to Cambridge. The Cambridge experience, especially his association with Professor (later Sir) Albert Seward, his mentor, not only made him a palaeobotanist in his own right, but prepared him for work in science and in the cause of science. Returning to India in 1919, Sahni held the chair in botany in the university at Varanasi for a year, and in the University of Punjab for another year. In 1921 he was appointed professor of botany in Lucknow University, a post he held until his death in 1949.

Sahni's enthusiasm for teaching, his passion for palaeobotany and its adjuncts geology, stratigraphy and archaeology, his qualities of leadership and exceptional organizing ability, and his capacity for hard work helped him in making everything he did peculiarly his own. In his new department, Sahni lectured to the students regardless of whether they were undergraduates or postgraduates. He got close to them in the practical classes, and closer still during excursions into the field, all a part of his package in instruction and learning. Sahni was no narrow specialist. He wanted his department to be another botany school on the Cambridge pattern. He therefore encouraged teaching and research in diverse areas, shunning no discipline, though his own speciality was palaeobotany. That is one reason why he is so relevant today when fashions and fads dominate and tend to submerge and subdue certain areas or facets of biology on which the very foundations of so-called 'modern biology' rest.

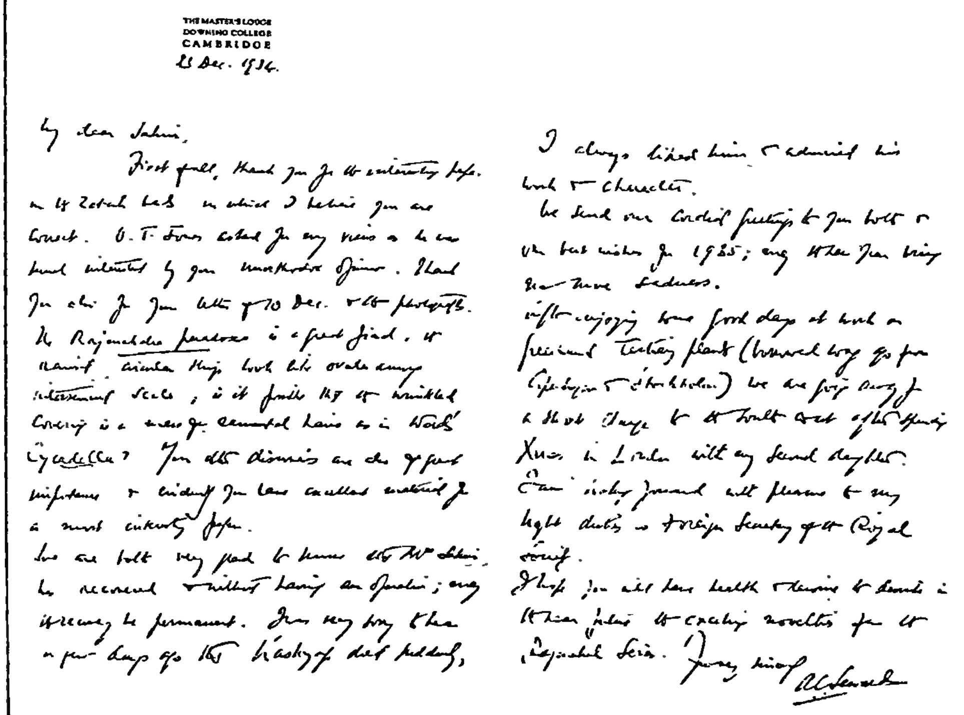
Sahni in his laboratory in the Botany School, Cambridge

Sahni's strategy for development of palaeobotany in its fullness in India is a fascinating story. Having found a suitable location for work in the botany department of Lucknow University, he unceremoniously plunges into the study of Indian fossil plants; but not before he has summed up the status of palaeobotany in India, and, in doing so, acknowledged in generous terms palaeobotany's debt to geology and geologists. Difficulties and impediments do not curb his enthusiasm. He launches a drive to procure material for his studies. But where is the material? With his knack and will to track down specimens from collections in museums, he succeeds in getting most of what he wants: his charm is mainly responsible for his gaining access to specimens of colleagues. To his horror he finds that many of the historic species can no longer be traced. Many of those available are not perfect, but in his hands, even a poor specimen always told a story or revealed some truth: for example, from a study of a fragmentary Australian specimen he described a *Clepsydropsis*. Sahni spends his summer vacations in Calcutta and studies the material available with the Geological Survey of India (GSI). But this will not do. Here was a rich field for original investigation, a veritable mine of material inviting attention. He must make his own collections. He collects, grinds the material, cuts sections. He works all by himself and examines the material. In the tradition of the great scientists of the past, he makes his own drawings (see his drawing of *Williamsonia sewardiana*, reproduced in this issue). Not until 1932 does Sahni formally admit a student for research with him, though a number of colleagues worked under his guidance earlier. After all, he needs someone to share and discuss his experience and thoughts. During the period 1933–1949, sixteen doctoral students work under his guidance. The emphasis is on quality, not numbers. He is concerned with work, nothing else. Self-reliance is the key to building up science in India; there is therefore no point in sending Indian material abroad for identification and report, and then publishing a paper thereon (but do we not continue to do this?); the study of Indian flora must be carried out by Indians themselves. This spirit dominates all his work.

Thus, palaeobotany in India, hitherto neglected, received a new impetus. Sahni began with a revision of Indian conifers from a study of the GSI material, first those preserved as incrustations or impressions, and then the petrified material. What a pioneering effort in consolidation this! There is little doubt that his study of the rare conifer *Acmopyle pancheri* carried out earlier kindled his interest in conifers. The mere description of the structure and morphology of seed-bearing parts of *Acmopyle* would not do for him. He reviewed the knowledge of the morphology of the ovuliferous scale in the group and, in his inimitable style, used his study of *Acmopyle* to propose a division of the gymnosperms into the stachyosperms and the phyllosperms—a division that eventually won support from later students of the science.

Sahni's own collections, as one would expect, turned out to be remarkably interesting, leading to discovery after discovery. These include the Bennettitalean plant *Williamsonia sewardiana* Sahni; *Homoxylon rajmahalense* Sahni, a new type of petrified wood (later named *Sahnioxylon rajmahalense* (Sahni) Bose & Sah); *Glossopteris angustifolia* Br., the discovery of which brought Sahni's attention to the importance of studying plant cuticles, living and fossil. Gradually, but steadily, Sahni's work extended beyond these. Critical studies of

A. C. Seward, Sahni's mentor in Cambridge



THE MASTER'S LODGE
DOWNING COLLEGE
CAMBRIDGE
25 Dec. 1934.

My dear Sahni,

First of all, thank you for the interesting paper on the Rajmahal beds in which I believe you are correct. O. T. Jones asked for my views as he was much interested by your unorthodox opinion. Thank you also for your letter of 10 Dec. & the photographs. The Rajmahalia paradoxa is a great find. the [illegible] circular things look like ovules among interseminal scales; is it possible that the wrinkled covering is a mass of cemented hairs as in Wieland's Cycadeoidea? Your other discoveries are also of great importance & evidently you have excellent material for a most interesting paper.

We are both very glad to know that Mrs Sahni has recovered without having an operation; may it prove to be permanent. I was very sorry to hear a few days ago the [illegible] of [illegible],

I always liked him & admired his work & character.

We send our cordial greetings to you both & our best wishes for 1935; may the New Year bring you more [illegible].

After enjoying some good days at work on specimens of Tertiary plants (borrowed long ago from Copenhagen & Stockholm) we are going away for a short change to the South coast after spending Xmas in London with my second daughter. [illegible] will [illegible] to my light duties as Foreign Secretary of the Royal Society.

I hope you will have health & leisure to describe in the near future the exciting novelties from the Rajmahal Series.

Yours sincerely
A C Seward

A letter from A C Seward to Sahni

the plant remains of the Gondwana sediments of the Salt Range, of the flora of the Karewas of Kashmir followed. One must cite also Sahni's work on petrified remains of palms—their identification and naming, and bringing their nomenclature in line with that of living palms; his study of remains of dicotyledonous plants such as *Enigmocarpon parijai*, and his recognition of the Pentoxyleae, a new and great group of gymnosperms, to accommodate different types of plant fragments from Nipania in the Rajmahal Hills. Reflecting typically Sahni's versatility and his curiosity is also his contribution on the methods of casting coins in ancient India. It is not easy to say which of these or other works is the most outstanding; rather, each radiates the brilliance and originality of the author.

The importance of geology to palaeobotany was almost an obsession with Sahni, but then it was just a fragment of his unshakeable faith in the unity of science. Science poses questions, and answers come from several disciplines and their interaction. This is especially true of the biological sciences. This is why Sahni was never content with the mere cataloguing or description of fossil plants. He moved within and across disciplines with gusto. He was a taxonomist *par excellence*. The taxonomy and nomenclature of fossil plants was built on critical studies not only of structure and morphology (including those of type or authentic specimens) but on 'distribution in time and space, range in structure, affinities and evolutionary tendencies, reactions to a changing geological background'.

All this implies a need of knowledge for living plants in unravelling relationships, getting insights into the evolution of plants, and even into climatic and other changes through the ages as part of the study of life then and now. Here then we find studies of living and extinct plants combined to an extent unparalleled. The discovery of the Gondwana flora and Sahni's early interest in geological events and in the theory of continental drift led him into studying the distribution of plants, past and present, and even tectonic movements. Thus, stratigraphical correlation, palaeogeography, climatology and earth movements were all within the ambit of his attention. Had he lived longer, I believe he would even have taken up the fascinating study of the origins of life. For he had an innate interest even in questions such as the origin of cutin and lignin, those 'mysterious substances', as he refers to them, which still distinguish vascular plants from their probable ancestors, the algae.

Given familiarity with the geological and stratigraphical record and the course of evolution of plants from the fossil record, the large-scale extinction of plants (and animals) and the sudden appearance of new forms from time to time are so striking that they must be reckoned by students of evolution as 'revolutions in the organic world' that are landmarks of geological history. Does it not strike the reflective mind that the sudden appearance of new species, genera and families is in sharp conflict with the Darwinian view of natural selection as the sole or even the primary factor in evolution? One may not dispute the concept of evolution as a gradual, orderly process of change, but, as Sahni notes, this is not the whole of organic evolution as revealed by the geological record. In his thought-provoking address to the National Academy of Sciences (reproduced in this issue), Sahni said, 'At all events the orthodox idea of natural selection through gradual accumulation of continuous variations utterly fails to explain some of the glaring facts of palaeontology'. The grand idea of continuity of plant life through the ages is in shambles.

In matters geological, and in matters controversial, Sahni was never hasty in passing judgement. In a letter to his friend D. N. Wadia, the geologist, he confesses, 'I am greatly handicapped, almost disturbed, by my ignorance of field geology.' While Sahni was generous in acknowledging geology's contribution to palaeobotany, he was also sore that geologists considered palaeobotanical evidence in dating rocks unreliable. And he spared no effort to put the matter straight to geologists. How could fossil data on dating, from plants and animals, be contradictory? These data would be complementary, not mutually exclusive.

Sahni's warm and vivid personality, his modesty and unostentatious nature, the brilliance and breadth of his science, the lure and lucidity of his lectures, the affection and attention he bestowed on his students sped him quickly to the top, where he remained, with a purpose and a mission. After teaching and research, which claimed most of his energy, there was still time for other work, prompted by the sole and untainted desire to build up the science, and build institutions and organizations in India as part of the effort towards self-reliance and keeping the national heritage intact. Along with P. F. Fyson and M. O. P. Iyengar (Presidency College, Madras) he founded the Indian Botanical

Illustrations of reconstructions of discs containing dies for casting coins from *The Technique of Casting Coins in Ancient India*, a monograph by Sahni published by the Numismatic Society of India in 1943

Society (IBS) and fostered it over a period of years. He also edited the society's journal for a time. One of the last things he did for the society was to edit a commemoration volume to honour his dear friend Iyengar. He was actively associated with, and involved in, the development of the Indian Science Congress Association. He was a foundation fellow of the National Institute of Sciences of India (now Indian National Science Academy), the National Academy of Sciences of India (Allahabad) and the Indian Academy of Sciences. Deeply concerned with education and research, he organized meetings where new and exciting discoveries could be presented and discussed, such as the symposium on the age of the saline series in the Salt Range of Punjab. The meeting was organized jointly by the Indian Academy of Sciences and the National Academy of Sciences. Before the meeting, Sahni wrote to C. V. Raman: 'As nearly every one of these geologists is firmly convinced that I am in the wrong, I am very keen that they should have the fullest opportunity of expressing their views at length.... I can therefore afford to let the others have the whole of the time after I have spoken for 15 to 20 minutes'. Incidentally, such a joint meeting by the two academies was also an effort by Sahni to bring them together. The idea of a situation where two national academies compete for recognition was anathema to him.

One finds a remarkable similarity of attitudes in Raman and Sahni: both were intent on developing science in India in a big way, something they believed had to be done by Indians on their own; by their own example, they also showed how this could be done; both shared a faith in the wholeness of science and the importance of the many facets that are part of the whole. I believe it is the latter that brought Raman and Sahni together and, at the joint meeting of the academies already mentioned, on a common forum. Consider an iron-willed Raman agreeing to such a meeting!

Sahni's initial difficulties in locating and obtaining Indian material of extinct plants led him to the strong conviction that all Indian material (fossil and living) must be held in Indian museums and herbaria. He was involved in a serious effort to retrieve valuable and historic material of Indian plants held by the Royal Botanic Garden (RBG), Kew, and getting a young Indian botanist stationed at Kew to work on Indian material as part of a programme to have Indian botanists trained for work in India. Suffice it to note that Sahni, along with S. P. Agharkar (Ghosh professor of botany, Calcutta University), and other fellow botanists, took up the case for India with the authorities. The success that came to them (but not without prolonged negotiation) in not only retrieving the material, but preventing material from being moved out of India, is a measure of their persistence, patience and diplomacy in dealing with a difficult situation. The correspondence between the parties concerned in this episode is revealing, and shows that Sahni played a pivotal role in it. Many of the letters between Agharkar and Sahni are handwritten. The clarity, diction and purposefulness of these letters are as compelling as the intense national sentiments and aspirations they convey. I should also mention here that a letter to *Nature* from Sahni and Agharkar presenting the Indian case was referred by editor Richard Gregory to Arthur Hill, director, RGB, Kew, and then, as one would anticipate, rejected. When it was returned to Sahni at Almora in June 1937, he was furious; he immediately endorsed copies to Agharkar, P. Parija (professor of botany, Ravenshaw College, Cuttack) and E. K. Janaki Ammal (secretary, IBS), saying: 'Full publicity to the facts should be given without much comment in *Current Science*.... This will prepare the ground before the Congress [the jubilee session of the Indian Science Congress, 1938] meets, and, perhaps, others will by then have contributed their views to *Current Science*'.

Sahni built and raised the department of botany in Lucknow University to the level of a centre of excellence of which we could justifiably be proud. He also started the department of geology. The Institute of Palaeobotany, which he founded, is a landmark in the progress of the science. His work was, and is, internationally recognized and acclaimed, and many

Birbal and Savitri Sahni

honours came to him. Colleagues and fellow botanists and scientists in India and abroad helped him with material and otherwise, and as long as Seward was alive he was a source of constant encouragement and support.

In 1920 Sahni married Savitri, daughter of Sunder Das Suri, a close friend of his father. Savitri Sahni stood by her husband throughout and it may be said that she was truly the lady behind the man's life and work.

Birbal Sahni was essentially a dreamer—such is my impression. And in so far as the fulfilment of his dreams was in his own hands, he succeeded. Success came from a long series of works, which I perceive as nothing but a single, enormous, evolving idea that offers insights not to be found elsewhere. Behind all the great science he did, and the inspiration he gave and his work still radiates, there is the artist who loved the beauty of nature. I note that he was interested in music and could play the sitar and the violin. That completes his personality. Alas, these days they don't make professors like they used to! The likes of Birbal Sahni are a vanishing breed.

Sahni's work was his mission and is also his message. Having said this, we may yet ponder over the vicissitudes of palaeobotany and the changing fashions of the day. Fashions come and go, as in an Oxford Street shopwindow, but palaeobotany lives. There is so much to do.

As the first flashes from the fissure volcanoes flared upon the eastern horizon, the stalwart Palm said to the little *Azolla*: This lurid light is not a sunset glow—it is the herald of the morn.

–Birbal Sahni

My own interest in palaeobotany raises the hope that I may help to bring this fascinating subject more prominently to the notice of my countrymen; and perhaps even succeed in inducing a larger number of them to turn their attention to the rich field that it offers for original investigation.

–Birbal Sahni

Greed comes to conflict with truth, and the passion to rule harnesses science to ignoble ends.

–Birbal Sahni

For all that science may have done to civilize him, man, it seems, can still be no less of a brute than he was. In the lurid light of happenings we see that the civilization is not the same thing as culture.

–Birbal Sahni