

# MEASUREMENT OF GEOLOGICAL TIME IN INDIA

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IN the spring and summer of 1924 I was working on the broad zone of unfossiliferous sediments in the south-west flank of the Pir Panjal range in Kashmir, which is such a feature of the geology of the middle Himalayas. This belt adjoins the Siwalik zone and the succeeding autochthonous zone (of Carbon-Trias-Eocene sequence), both of them fossiliferous and well documented. It is separated from the last-named zone by a thrust-plane, the second and largest thrust-fault of the Kashmir Himalayas. The totally barren nature of this 12-mile wide belt of comparatively little metamorphosed sediments, otherwise admirably constituted to preserve any relics of life, lying amidst a varied succession of fossiliferous systems of Kashmir, ranging from Cambrian to Eocene, is a puzzle; and to come across mile after mile of well-bedded sediments, obviously deposited in quiet waters of rivers or in the marine-littoral, totally lacking in any evidence of fossil remains, is one of the most baffling experiences of work in Himalayan geology. Dr. G. E. Pilgrim, Superintendent of the Survey Party, was in camp with me at the time and we had both been trudging along and across the Dogra Slate and the Tanawals (? Lower Gondwana) belt for weeks, with no light dawning upon the age or stratigraphic position of these wide formational units of the Panjal range. Birbal Sahni, who was then vacationing at Kashmir, to our agreeable surprise, marched in one afternoon in pouring rain. He had a standing invitation from me to visit my camp (he was wanting to botanize in the Pir Panjal area) and he thus came on the scene that day, 12th May, after long and arduous marches from his Gulmarg holiday. We both welcomed him and he threw himself with his characteristic ardour and vigour into the geologists' search for fossils. It was a unique experience for me to have Pilgrim, author of the most brilliant memoirs on Indian palaeontology, and Sahni, who was soon to blossom into a noted palaeobotanist, collaborating on this blank geo-

logical patch. We had three or four joint camps in this area for 12 days in rather adverse circumstances, snow, rain, long steep ascents and bad roads. Sahni's enthusiasm, for all this, was well sustained, and after the day's work, we used to have long and profitable after-dinner discussions in our tents, at times shaking with hailstorms. The search for fossils, however, proved fruitless.

The uranium-lead and U-helium ratio tests were then not so perfected and not much in vogue and the microfossil technique was unknown in India. So geologists had to be content to seek stratigraphic and tectonic criteria in assigning horizons to undatable rock-groups. But it was experience such as this (also met with, perhaps in a more intense form, in Simla, Garhwal and more eastern Himalayas), added to the unusually wide stretches of unrelatable geological systems covering three-fourths of a million square miles of the Deccan terrain, that 22 years later led to the institution, by the Board of Scientific & Industrial Research, of a Committee for research on Measurement of Geological Time in India. Here are widespread pre-Cambrian and (?) Palaeozoic formations which are devoid of any geological data regarding their position in the Standard Stratigraphic Column. In the aggregate thickness of India's sedimentary record they occupy, at several horizons, positions of critical importance. So far they have been regarded as blank pages of geologic history, but there is a possibility that they may possess data in the shape of radioactive minerals, or attrited plant and animal fossil micro-organisms, which would enable modern science to fix the period or era they occupy in the long vista of Absolute Time since the earth came into existence as a separate planet. Sahni was invited to join this Committee as a member in 1946 for the aid the new technique he had so well established at Lucknow could give in detecting microfossils in apparently barren sedimentary rocks. It is a misfortune that Providence has not spared him

to complete the work which he so enthusiastically began and which, there is no doubt, would have helped the geologists and geophysicists of the Committee in establishing the chronology of some obscure chapters of Indian geology.

The experience of the last few decades has shown that the old purely geological methods of estimating the age of the earth, or measuring the duration of the principal eras and epochs of earth history have remained static and are not capable of that degree of refinement and exactness which recent progress in nuclear and atomic physics has enabled physicists to bring to bear on the solution of the problem. But in those cases where geophysical tests are inapplicable, by reason of the absence of any associated radioactive

compounds in the rock-assemblages, microfossil technique still remains the only weapon in our hands for attacking obscure rock formations. Microbiological method may not provide absolute data, but they will be of help in establishing relative chronology and may suggest correlations. The Institute which Prof. Sahni has brought into being has, therefore, a wide field of work before it, and we may hope that in the fullness of time it may be able to solve the problems presented by our *Blainis*, the *Tals* and *Tanawals*, the *Krols* and *infra-Krols*, the age of the *Cuddappahs* and *Vindhyan*s, the problem of our *Middle Gondwanas*, and the enigma of the Salt Range Cambrian? rock-salt and dolomite beds containing angiosperm plant debris.