with strong experimental evidence. There are still to be found old-fashioned fishermen who have attained within a certain range to a wonderful seamanship of an empirical sort; they have built up a body of associations from wind and from wave, from the sky and the "feel" of the sea, and they are seldom far out in finding their way home. And so it is with the higher ants, except that they work even more exclusively from an instinctive basis.

It must be remembered that the orientation power of ants does not stand magically alone. Even brainless animals adjust their body in a position of physiological equilibrium in relation to a stimulus of light or warmth or gravity—a static orientation. When there is direction of locomotion in relation to an external stimulus, we speak of dynamic orientation. This dynamic orientation may be direct or indirect. It is direct when the stimulus or goal is within the range of immediate sense-perception, and it must be noted that for ants this range is only about a yard. Of this locomotor orientation there are various grades—tropistic, reflex, instinctive, and acquired, the first three expressing a hereditary predisposition, the fourth expressing the results of the individual's own learning. On a higher level is indirect orientation, where the goal is beyond the range of direct sensory perception. A complex of imprints or memories, corresponding to the goal, functions in the animal's sensorium, and forms the unifying centre of a whole series of imprints of the environment of the goal. What leads the creature on from step to step—often quickly and, so to speak, unquestioningly, if no contradictory interruption occurs—is the recognition of localised stimuli corresponding to those of the unified reference series. The orientation implies a chain of recognitions, and the recognitions imply a registration of individual experiences. Without using Brun's somewhat forbidding mnemic terminology, we cannot do justice to his carefully worked-out theory, but we have indicated its general nature. It is essentially what may be called psycho-biological, for he thinks of the organism as a historic being that trades with time, that enregisters imprints, and that has its past living in its present, as Bergson has accustomed us to say. These imprints, which the individual ant selectively accumulates, are not like sheets filed in a portfolio of reference; they are interpenetrated with and kept alive by their meaning for the actual everyday life.

PROF. JAMES GEIKIE, F.R.S.

BY the death of Prof. James Geikie, Edinburgh and its university have been deprived of one of the most prominent of its men of science, and geology has lost a distinguished investigator and successful teacher. The son of J. S. Geikie, of Edinburgh, whose literary talent found expression in a number of popular Scottish songs, the subject of this notice was educated at the high school and university of his native city, and in 1861, when only twenty-two years of age, received an appointment upon the Geological Survey of Scotland, a service in which his elder brother, Archibald, had already been engaged for five years. James Geikie's work as a surveyor lay chiefly in the south-west of Scotland, and in 1869 he was promoted to be a district surveyor; his studies seem to have been more particularly attracted, from a very early date, to the post-tertiary deposits, and in various papers in the scientific journals, as well as in the official memoirs of the survey, he published the results of his observations and his conclusions based upon them. Early in his career, James Geikie had become a great admirer and warm friend of Andrew Ramsay, then director of the English Geological Survey, and Ramsay's theoretical views and speculative suggestions found a stout supporter in the young Edinburgh geologist. In 1876 the Colonial Office requested Ramsay to proceed to Gibraltar in order to report on the important question of its water-supply, and James Geikie was chosen to accompany and assist him. In addition to the valuable report made to the Government, the two geologists were able to contribute to scientific journals memoirs dealing with the geology of Gibraltar, and especially with the superficial and cavern-deposits, and their bearing on the history of the Mediterranean in post-tertiary times.

In 1874 James Geikie had already published his conclusions concerning the history of the Glacial period in Britain in his well-known work, "The Great Ice Age," which has passed through three editions; and in 1881, after devoting his vacations to travel on both sides of the Atlantic, he extended the bearings of his views on the subject by the publication of his "Prehistoric Europe."

In the following year, however, James Geikie entered upon a new field of labour. The appointment of his elder brother to the directorship of the Survey necessitated his vacation of the Murchison professorship of geology at Edinburgh, and James Geikie received the appointment, resigning his position on the Survey. During his energetic and successful work of teaching, carried on for more than thirty years, he published a number of very valuable educational books: "Outlines of Geology," of which four editions were called for; "Fragments of Earth Lore"; "Earth Sculpture," two editions; and "Structural and Field Geology," three editions. His labours were not by any means limited to the special subject of his studies; he was one of the founders of the Royal Scottish Geographical Society, acting as editor of its journal, and for a time as president of the society. He was also for many years dean of the faculty of science in Edinburgh University. In 1875 he was elected a fellow of the Royal Society, and in 1889 received the Murchison medal of the Geological Society, while he was a member and correspondent of many scientific societies at home and abroad.

It was not only in his numerous scientific writ-

ings that James Geikie's hereditary literary instincts were exhibited, for he published in 1887 a series of translations from the German, "Songs and Lyrics by Heinrich Heine, etc." His frank manner and *bonhomie* won him many friends, and we may well believe that, though an ardent golfer, like so many other Scotchmen, he gave expression to the sentiment ascribed to him that he found a still more pleasant means of recreation in "loafing in pleasant places with a congenial friend." J. W. J.

EMILE-HILAIRE AMAGAT.

BY the death of M. Emile-Hilaire Amagat at his country estate at Saint Satur in the department of Cher, France loses one of her most distinguished physicists. Born in 1840, he held several minor teaching appointments before becoming professor at the Ecole Normal at Cluny. Here in 1867 he commenced his researches into the behaviour of gases under high pressures, which rapidly brought him into the front rank as an experimentalist. At Lyons, where he had become professor at the Catholic university, he utilised the tower of one of the churches as the site for a mercury manometer giving pressures up to 80 atmospheres, and in one of the coal mines of Saint Etienne constructed one up to 430 atmospheres. His observations on nitrogen at these pressures enabled him to use the nitrogen manometer in his experiments on other gases, on liquids and solids, and on the conditions of transition from one state to the other. By the help of a skilled mechanic he had himself trained, he was able to construct apparatus for observations at pressures up to 3000 atmospheres. His results, which appeared for the most part in the *Annales de Chimie et de Physique,* were summarised in memoirs of dates 1883 and 1893, and his curves showing the variation of the value of pv as p increases for hydrogen, nitrogen, and carbonic acid have been reproduced in standard text-books for the last twenty years.

In 1892 Amagat was elected an honorary member of the Literary and Philosophical Society of Manchester, and in 1897 a foreign member of the Royal Society of London. After going to Paris as examiner for admission into the Ecole Polytechnique, he was in 1902 elected member of the Académie des Sciences. In 1906 he was president of the French Physical Society, and soon after was elected one of its few honorary members. Although offered a professorship at the Ecole Polytechnique, he preferred his examinership, and continued to devote to research much of the leisure it allowed him. During the last few years his health kept him at his country house, and for several months before his death he was confined to his room. For a generation he had been one to whom younger men could appeal for advice and encouragement in their work, and many distinguished physicists of to-day recall with affection his kindliness, his sincerity, and his modesty. C. H. L.

NOTES.

THE prospectus of British Dyes (Limited), which was put before the public a few days ago, has evoked universal condemnation in the daily Press. As might perhaps have been anticipated, the board of directors does not include a single representative of science, whilst the directors appointed by the Government consist of a railway director and a civil engineer. This characteristic neglect of science, and its consequences, form the subject of two letters by Sir William Ramsay and Sir Henry Roscoe, published in Wednesday's *Times*. Sir William Ramsay gives numerous instances to show that scientific chemists *must* form an important part of the directorate if the scheme is to be a success. The Castner Kellner process has on its board Sir Henry Roscoe and Dr. Beilby. The ammonia-soda process, originally patented by Dyer and Hemming, was successfully introduced and managed by the late Dr. Ludwig Mond. The paraffin industry was due to the late James Young, at one time an assistant of Prof. T. Graham. Perkin's and Spiller's names are associated with the early days of synthetic colours. These men were both pupils of Hofmann at the Royal College of Chemistry. The firm of Spencer, Chapman, and Messel, which has for many years manufactured sulphuric acid by the contact process, owes its inception and success to Dr. Messel. Turning to metallurgy, Lowthian Bell and Bessemer were scientific chemists first; successful manufacturers after. In short, it would be difficult to discover a successful chemical industry which has not been initiated and controlled by a chemist. Unless "British Dyes (Limited)" copies this precedent, there is little hope for it.

SIR HENRY ROSCOE, in the letter referred to above, points out that it is not the manufacture of the well-known colours of indigo, alizarin, or methyl blue which will bring financial and final success to British Dyes (Limited). The preparation of these articles—which, like all complicated chemical processes, requires both knowledge and great care—is on well-known lines. It is the new thing which makes a business success. "In the colour industry it is then the research chemist, and he alone, who can keep the flag flying, for he alone can bring forward new forces and create new developments. Capital cannot do it, business capacity cannot do it, but the brains, the imagination, the skill, and the knowledge of the research chemist can." Yet though this is the case, so far at least, the research chemist is to have no voice in the direction of affairs in the new colour company, but merely to be called in as an expert when, in the opinion of his business superiors, he can help them to solve some difficulty. If this plan is persisted in and the scientific chemist is not given a voice in the management "success is improbable, if not impossible."

THE Bakerian lecture of the Royal Society will be delivered on Thursday next, March 18, by Prof. W. H. Bragg, upon the subject of "X-rays and Crystals."

WE regret to see the announcement that Principal Sir James Donaldson, Vice-Chancellor of the University of St. Andrews, died on Tuesday night, March 9, at eighty-three years of age.