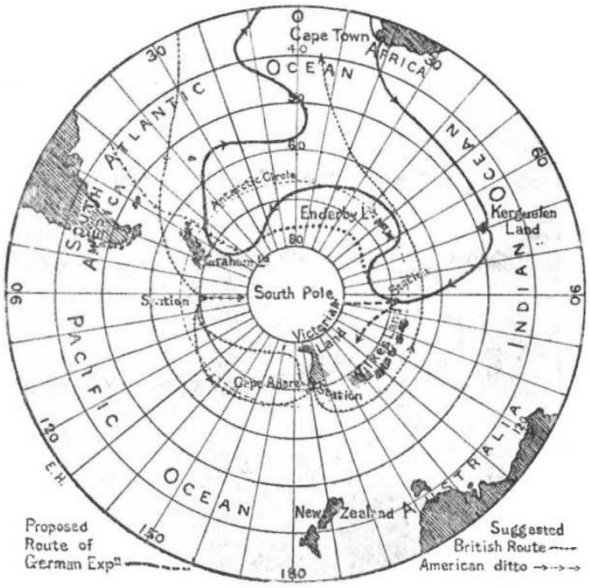
mathematician Gauss, who by his work on terrestrial magnetism gave the impulse to the three expeditions of D'Urville, Wilkes and Ross, to the last of which we owe the whole groundwork of our scientific knowledge of the South Polar region. Although the work of Cook and his successors proved the non-existence of an Antarctic continent valuable from a commercial point of view, it is still the fact that their voyages have—unlike those to the North—brought to light more and more fragments of land, and led to the involuntary conclusion that a continent does lie in those regions.

From a geographical point of view, the fundamental problem attached to the South Polar region—the verification or disproof of the existence of such a continent—is still unsolved. No less important questions likewise await solution with respect to the geological structure and character of the southern lands—so important in connection with a knowledge of volcanic action and the supposed former connection of South America with Australia—and with respect to the conditions of inland ice. It was pointed out by the speaker that even the study of the floating ice broken away from the main mass may lead to important conclusions as to its mode of origin, and the nature of the land from which it comes. Other problems to be investigated are: the origin of the cold ocean currents which take their rise in the south; the conditions of atmospheric pressure and temperature in that region; and the questions relating to terrestrial magnetism, which have so important a bearing on the practice of navigation. Lastly, Dr. von Drygalski alluded, like Sir Clements Markham in this country, to the importance of such an expedition from the point of view of practical training to navigators, and the upholding of national prestige; while he also pointed out the advantages of international co-operation by the sending out of simultaneous expeditions.

The section of Dr. von Drygalski's address which will be read with most interest is, perhaps, that relating to the plans which have already been formed for the carrying out of the enterprise. He began by pointing out that the present seems a particularly favourable period for the resumption of South Polar research, by reason of the unusual amount of drift-ice which has within the last few years broken away from the main mass. This, together with the fact that we are now, according to Supan, passing through a warmer temperature-period, should make the next few years unusually favourable to navigation, and suggests as the most suitable starting-point for an expedition the Southern Indian Ocean, where drift ice has been particularly abundant since 1894. Such a choice also fits in well with the suggestions which have been made with regard to an English expedition, the Southern Pacific and Victoria Land having been mentioned as the probable sphere of the latter. Proceeding southwards on about the meridian of Kerguelen Land, and making *en route* the necessary scientific observations of all kinds, the expedition would attempt to reach some land where a winter station could be formed, and where systematic observations would be continued at the edge of the ice-sheet. In the spring an advance would be attempted southwards over the ice and towards the Magnetic Pole. In the autumn a return would be made as far as possible in a westerly direction along the coast-line supposed to be discovered, the programme being completed within about two years from the date of sailing. The accompanying sketch-map, based on one which accompanies the report of the meeting in the *Verhandlungen* of the Berlin Geographical Society, shows the proposed route in accordance with the above programme. On account of the stormy nature of the southern seas, the lines adopted for the construction of the *Fram* will not be suitable, seaworthiness being the first requisite. Ice-pressure is less to be feared in the south than in the north, since the currents radiate outwards instead of inwards; and the necessary strength can be supplied by internal supports. For many reasons it is thought unnecessary to despatch more than *one* ship, one having proved sufficient for recent North Polar voyages, while the movements of one ship are often hampered by the endeavour to keep in company with a consort. Should the vessels separate for the better prosecution of scientific work, there would be two expeditions, not one, and no additional security would be gained. The vessel should be built of wood, both for its advantages in ice-navigation and to allow of undisturbed magnetic observations. These, with those concerned with meteorology, formed the subject of special remarks by Dr. von Bezold, who pointed out the



Sketch-map of South Polar Region.

particular value attaching to such observations in the region in question.

The whole plan of the expedition seems to have been well thought out, and, judging from his previous services to polar research, the scientific work could not be in better hands than those of Dr. von Drygalski. It is to be hoped that the remaining difficulties may speedily be overcome, and that the result may be an important addition, within the next few years, to our scanty knowledge of the southern regions.

THE SIKHIM HIMALAYAS.[1]

OUR ignorance of the Eastern Himalayas is simply astonishing. It is hardly credible that for nearly 1000 miles, from the western extremity of Nepal (long. about 81° E.) to the eastern end of Assam (long. 96° E.) there is only the one small tract of Sikhim, barely fifty miles broad, in which the higher mountains are accessible to Europeans. Throughout Nepal and Bhutan and in the wild forest tracts, inhabited by barbarous Indo-Chinese tribes, east of the latter, none of the rulers of British India can show their faces.

But even in the small mountain region that is open to exploration very few travellers take advantage of the opportunities afforded to them. In the book before us, the author justly insists on the great superiority of the Eastern over the Western Himalayas in scenery. Whether he is right or not in calling the magnificent panorama seen from Senchal, close to Darjeeling, "the

[1] "Among the Himalayas." By Major L. A. Waddell, LL.D., F.L.S., &c., Indian Army Medical Corps. Pp. xvi + 452. (Westminster: Constable, 1899.)

grandest snowy landscape in the world," it is certainly questionable whether a grander view is known. One reason amongst others why the prospect of the snowy range from Darjeeling so greatly excels that from Simla, for instance, is that the high snow-clad peaks are only half as far distant from the former as they are from the latter. Nevertheless, the higher Himalayas north of Naini Tal, Mussooree and Simla attract far more European travellers than the higher ranges of Sikhim because of the great difficulty and expense of journeying in the latter country. Where there are practically no roads, no rest-houses, no facilities for the conveyance of baggage or provisions, and only very small and precarious supplies of food, where everything, from tents to cooking-pots, for a traveller and his guides and followers has to be carried by porters brought from a distance, over steep hillsides in dense forest, along precipices only to be climbed by bamboo ladders, and across raging torrents spanned by swaying cane bridges that afford, by the insecurity of their fastenings and the tenuity of their foothold, a lively conception of the approach to the Mahommedan Paradise, it is not surprising that but few travellers care to face the difficulties of the journey. It is true that within the last decade a few bridle roads have been made and rest-houses built, here and there, but still travelling in the interior of Sikhim is by no means so easy as in the Western Himalayas.

Yet Sikhim has many attractions besides its scenery. The fauna and flora are wonderfully rich and interesting; of birds alone nearly 600 species are known to occur, or about as many as are found in the whole of Europe, and the inhabitants afford a remarkable anthropological problem. Major Waddell, the author of the work before us, has peculiar advantages in undertaking a description of the country, for not only has he spent many years in studying the languages, religion and customs of the principal inhabitants, the aboriginal Lepchas who cultivate the lower elevations, and the Tibetans or Bhotias who occupy the higher habitable tracts, but he has also devoted considerable attention to the natural history of the country. He was the author of a very large portion of the *Gazetteer* of Sikhim, to which he contributed an excellent description of Lamaism or Tibetan Buddhism, and also a list, with numerous notes, of the Sikhim birds. Although his present work, "Among the Himalayas," wants the charm of Hooker's delightful "Himalayan Journals," treating of the same area, it contains a good descriptive account of Sikhim, with many excellent illustrations.

The book consists of notes on journeys made at different times through various parts of Sikhim, chiefly by the author himself. He was unfortunately prevented from visiting the Lachen valley and its tributary the Zemu, leading to perhaps the most interesting corner of the country, north of the great snowy mountain Kanchenjunga; and this is particularly to be regretted, because the tract specified has hitherto been very briefly and imperfectly described, though some beautiful photographs were obtained, of which one is now reproduced. Almost all of the routes traversed by Major Waddell had been previously described by Hooker or by other travellers; but the present work adds much useful information, as it is the first written by any one familiar with the languages and customs of the people. The illustrations, chiefly photographs of the scenery and of the people, their dwellings, monasteries, &c., reproduced by some of the processes now so largely used, are not only very numerous, but also well selected and, in the majority of cases, effectively printed. No better representations of Himalayan scenery have ever been published on a small scale.

It is impossible here to discuss the numerous subjects noticed by Major Waddell, but there is one of general interest—Mount Everest—to which he makes an im-

portant contribution. In the first place he not only confirms, by clear and independent evidence, the decision accepted by the officers of the Great Trigonometrical Survey of India, that the names such as Gaurisankar, Deodhunga, &c., applied by B. H. Hodgson and H. Schlagintweit to the highest peak of the Himalayas, do not belong to it at all, although the first of them has been extensively used on German maps, but he also shows that there is a Tibetan name *Jomo-kang-kar*, meaning "The Lady White Glacier," which apparently does apply to the culminating peak of the Everest group. Secondly he points out that, according to the Tibetans, there is another mountain, due north of Mount Everest, that exceeds even that peak in height, and must therefore be the highest mountain in the world, unless some other Tibetan peak, as yet unmeasured, exceeds it. Apparently no European has yet set eyes upon this mysterious summit of the upper Lap-chi-kang; its discovery and measurement afford a grand opportunity for a future geographer and explorer. Before quitting this subject, a hope may be expressed that no one will be found so utterly lost to all sense of humour as to adopt the barbarous hybrid term of *Kong-kar-Everest* for the monarch of the Himalayas; it is astounding to find Major Waddell writing calmly of the matter, and apparently without any appreciation of the fact that the name is absurd. This is the more surprising, for Major Waddell is justly severe on the ignorance which insists on adding superfluous aspirates and other letters to native names, and he reproves the people who write "Thibetian" for Tibetan and "Gnathong" for Na-tang.

Major Waddell has paid great attention to Sikhimese birds, but he appears to have a rather imperfect acquaintance with the mammals. He writes of the "marsh-deer or sambhar" (p. 260) apparently under the idea that both are names applied to the same animal, he calls the *Goomcher* or *Gumchen* of Tibetans a tailless rat or marmot, whereas it is a *Lagomys* or pika, and he even writes of the Serow, a goat-antelope, as the Serow deer. He must have been misled by some of his followers into supposing (p. 113) that tracks he saw on Tendong, a few miles north of Darjeeling, in oak and magnolia forests, about 8500 feet above the sea, were those of Bharal, *Ovis nahura*, an animal that does not inhabit this part of Sikhim, and that never enters forests at all. It may be added that, especially with regard to Latin names, the book appears not to have been read quite as carefully as is necessary, for *Ovis nahura* becomes *Ovis nehur* on p. 113, and *Ovis nätura* on pp. 216 and 225; whilst *Nectrogale* for *Nectogale* (p. 219), *caerulus* for *caeruleus* (pp. 77, 240), *Grandula* for *Grandala* (p. 216), and *Calliophis* for *Callophis* (p. 77), are other instances of misprints. To some extent names of places suffer from the same want of revision; thus the Sibu Pass of the map and Seeboo Pass of p. 215, is apparently the Sherboo Pass at p. 161. Another curious case of oversight is the statement, on p. 330, that the peaks of the Everest group are shut out from view at Senchal by a dark ridge, although a figure of the peaks in question, as seen from Senchal, is given on p. 33; the fact being that it is the lower portions of the Everest group, not the peaks, that are shut out.

These, however, are minor drawbacks, and do not prevent the work from being a valuable addition to Himalayan literature. W. T. B.

PROFESSOR SOPHUS LIE.

IT is with much regret that we have to announce the death of this distinguished Norwegian mathematician, which took place on February 18 of the present year.

Born at Christiania on December 12, 1842, he graduated as Doctor in the University of that city in 1868. Four years later he was appointed professor extraordinarius of mathematics; and in 1886 he succeeded Klein as professor at Leipzig, when the latter was nominated to Göttingen. During the last few years a strong desire has been felt by his fellow-countrymen that he should occupy a professorship in his native country, and that a post should be specially created for him in Christiania. It was only quite recently that this desire had been gratified; unhappily too late to be effective. His strength had been undermined by the intense ardour with which he pursued his investigations; and his health, thus broken, has forbidden any long tenure of a chair in which, as had been hoped, he would be able to continue his mathematical researches.

When once the merit of his work began to be recognised, scientific honours were bestowed upon him freely. He had received the honorary or foreign membership of societies and academies in great numbers; in particular, in England alone, he was enrolled among the foreign members of the Royal Society, and among the honorary members of the Cambridge Philosophical Society and the London Mathematical Society.

The list of his scientific productions includes over 100 papers, many of them of considerable length, and six volumes. Probably he will be best known by the treatise "Theorie der Transformationsgruppen," in the preparation of which he was assisted by the loyal devotion of Dr. F. Engel. It is a work of great originality, containing many methods and a wide range of development; it exhibits in masterly manner the suggestive application of new methods to fundamental subjects; and it may be described briefly as a systematic exposition of Lie's investigations on groups of transformations that are continuous and finite. Among the subjects to which application is made, may be mentioned the theory of ordinary differential equations; the theory of partial differential equations, both single and in systems; differential invariants and their types; the solution of Pfaff's problem; tangential transformations, specially in spaces of two and three dimensions, and more generally in n dimensions; groups of functions transformable into one another, and a substantial simplification (by the use of their properties) in the integration of systems of partial differential equations; a complete determination of types of the groups of transformation in one, two, and three variables, and a partial determination of those in n variables. It concludes with a profound study of the foundations of geometry from the point of view of Riemann and Helmholtz; and after a critical discussion of the significance of the hypotheses which they made, he propounds a solution of his own, based upon more elementary hypotheses.

In a couple of instances, his lectures in amplification and elucidation of portions of his theory were edited and published in volume form by Dr. G. Scheffers, whose help is gratefully acknowledged: one of these relates to differential equations that admit of known infinitesimal transformations; the other to continuous groups.

Two other works were promised by him. One of these, to be written in co-operation with Dr. Engel, was to deal with the theory of infinite continuous groups and the application of the general group-theory to the integration of differential equations: this work has not appeared. The other, to be written in co-operation with Dr. Scheffers, was to be devoted to a systematic exposition of his geometrical investigations; the first volume has appeared under the title, "Geometrie der Berührungstransformationen."

As already indicated, his name at the present time would probably be associated most closely with the theory of continuous groups. An inspection of his memoirs, however slight, is sufficient to indicate his keen and essential interest in the domain of geometry. But while his method was that of the group-theory, and while his investigations so frequently referred to geo-