of the Murghab. To the north-west both rivers are lost in the sands of the desert. The Hari-Rud is crossed by a bridge ninety-seven yards long. From this point it was formerly a distance of ninety kilometres to the nearest fresh water, but this has been diminished to forty-eight kilometres by a canal constructed by Colonel Alikhanoff during the past season. This diverts part of the water of the Murghab, but it was found impracticable to extend it further. The latter river, unlike the Hari-Rud, does not dry up, but carries in winter seventy-five cubic metres per second as against three hundred in summer. It contains about two per cent of earthy matter, amounting, for the annual epoch of floods, to about fifty million cubic metres of mud, which is spread by the innumerable irrigating canals over the surface of the Merv oasis. The destruction in 1784, of the great dike of Sultan Bend, much diminished the irrigated and fertile area. The Russian government has reserved sixty thousand rubles to rebuild this dike, and it is expected that nearly four hundred thousand acres will be reclaimed by this work, and, in time, nearly four times as much more. This land, when irrigated, is of extreme fertility, wheat producing a crop of one hundred bushels for every bushel sown. Merv is growing rapidly: town lots of a certain size are given away, on condition that the receiver builds upon them at once. The streets are wide, with broad footwalks, planted with trees, and bordered with small canals. The oasis is confidently expected to develop largely in the near future.

PHOTOGRAPHIC STUDY OF STELLAR SPECTRA.

THE study of stellar spectra by means of photography was one of the most important investigations undertaken by the late Prof. Henry Draper. He was actively engaged in this research during the last years of his life. His plans included an extensive investigation, one object of which was to catalogue and classify the stars by their spectra. Mrs. Draper has made provision, at the observatory of Harvard college, for continuing these researches as a memorial to her husband. The results already obtained, with the aid of an appropriation from the Bache fund, permit the form of the new investigation to be definitely stated. The part of the sky to be surveyed is that extending from the north pole to the parallel of thirty degrees south declination. Each photograph will be exposed for about one hour, and will include a region ten degrees square. The telescope employed has an aperture of twenty centimetres (eight inches), and a focal length of a hundred and seventeen centimetres (forty-four inches). The object-glass is covered by a prism, and the resulting spectrum of each star in the region photographed has a length of about one centimetre, which enables the character of the spectra of stars from the fifth to the eighth magnitude to be determined. A modification of the apparatus is employed for the brighter stars.

Meanwhile, experiments are in progress with the fifteen-inch equatorial, with the object of representing the spectra of some typical stars upon a large scale. The spectra so far obtained are about six centimetres in length, and exhibit much well-defined detail. Additional experiments will be tried with a spectroscope provided with a slit, as well as with the simple prism hitherto employed, in order to secure the best possible definition. The present results encourage the expectation that the movements of stars in the line of sight may be better determined by the photographic method than by direct observations.

To keep the astronomical public informed of the progress made in this work, specimens of the photographs obtained will be gratuitously distributed from time to time. The first of these distributions will probably be made in a few weeks. Owing to the expense of providing a large number of copies, it is desirable to limit the distribution, so far as possible, to those who are interested in this class of work. It is also desired, however, to send the specimens to all who will find them of value from the scientific point of view. Requests should be sent to the Harvard college observatory by any one desirous of receiving the specimens. EDWARD C. PICKERING.

THE HUDSON BAY ROUTE TO EUROPE.

LAST year there appeared in *Science* (vol. v. No. 110) an account of the Hudson Bay expedition of 1884, accompanied by a track-chart showing the route followed. Lieutenant Gordon's official report of his last summer's trip to the bay, to relieve the observers at the stations established in the strait in 1884, is included in the annual report of the Canadian department of marine, lately submitted to the Dominion parliament. It is in narrative form, and contains little new information, the results of the observations conducted at the several stations being reserved for publication as a separate report so soon as they shall have been reduced to proper form.

Lieutenant Gordon, after promising details of the observations at an early date, concludes his report with the following remarks on the prospects of navigating the strait: "The reports go to show that the ice set fast in the western end of

the straits during the last week of October, 1884, and that for all practical purposes of navigation the straits remained closed at this point till the early part of June in the present year. In June a good deal of open water was seen at different times, but the pack would close up again, and remain in that condition for several days at a time.

"From a consideration of these reports, I am of the opinion that it might have been possible to pass through the straits during the early part of this July. The same date of closing as shown by the observations last year would give a season of navigation rather less than four months for the individual season.

"It should, however, be stated, that the movements of ice this spring were evidently much later than those of last year; for in the month of August this year we met with vast quantities of heavy ice, and in the same month last year comparatively little was seen. On the Labrador coast and at Churchill the report was the same, — that the ice was unusually late in leaving this year.

"I was informed by a captain who had made a number of voyages through Hudson's Straits, that he had seen the straits clear of ice in June, but that it was a rare occurrence. The fact, however, that the straits had been clear at this time, shows that there is a great variability in the dates of the opening of navigation."

The above conclusions scarcely seem to justify the building of a railway from Winnipeg to Churchill, — a scheme so seriously contemplated, that one or more companies have been organized, an extensive preliminary survey made, proving the feasibility of the route, and the requisite capital actually promised; while one of the engineers has gone so far as to assert that the bay and strait were navigable for properly constructed vessels all the year round.

The observers at all the stations report that the huts were warm and comfortable, the food good and sufficient, and their health, except in the instances mentioned, excellent. The weather was not nearly so severe as expected, the thermometer never going so low as it often does in inhabited portions of the north-west.

THE PANAMA CANAL.

IT has been reported in the daily papers from time to time, during some months, that matters at the Isthmus of Panama were in a bad shape, that the funds previously subscribed and loaned were nearly exhausted, and that but a small portion of the necessary excavation had been completed. Apparently to counteract the impression made on the public mind by these statements, M. de Lesseps, on his brief visit of inspection of the work in progress on the canal, from which he has just sailed for France, was accompanied by delegates from various commercial cities of Europe and this country, and an engineer was also despatched by the French government to report upon the state of affairs, before a decision should be made in regard to the advisability of allowing a further sum of money to be raised and borrowed for the canal.

In the supplement to No. 148 of *Science* (vol. vi.) there appeared a notice of the recent book by J. C. Rodrigues, on the Panama canal, which, from his point of view, showed that the canal construction had been shamefully mismanaged from the start, and that failure and bankruptcy were imminent. There has just issued from the press another work[1] on the same subject, written by one who has had a large, if not the largest, share in the preliminary investigations, in the deliberations of the canal congress, and in obtaining the territorial and other concessions, and has had the best of opportunities for knowing about the progress of the work, — Commander Lucien N. B. Wyse. As will be inferred from the sub-title, the author aims to give an exhaustive account of the matter, from the very earliest explorations, through the discussion of the several proposed routes, a critical analysis of the points for and against the eleven most promising lines, an account of the political and business negotiations with other countries, the concessions secured, and the views and arguments of the United States authorities, down to the present state of the work (October, 1885), the money already expended and the future prospects. The admirable map which Commander Wyse gives, of that portion of Central America and the isthmus in which lie his several projected routes, is reproduced with this issue of *Science*, and the accompanying profiles show in metres the elevation of the ground over the different lines. The book contains also a plan of the Panama canal as it is to be when completed, and some ninety woodcuts of isthmian scenes and views of the canal-works.

The volume is very handsomely printed; and a person, whether interested or not in the canal, will find the opening portion, describing the scenery, the flora and fauna, the geological formations, the climate, the inhabitants, and the mode of life in that part of the world, very readable. Space will not permit the giving of an ab-

[1] *Le canal de Panama, l'isthme américain; explorations; comparison des traces étudiés; négociations; etat des travaux.* Par LUCIEN N. B. WYSE. Paris, *Hachette*, 1886. 8°.