

not observe it at maximum. A further examination is therefore required. Bright lines should also be carefully looked for, in order to determine whether the appearance of bright lines at the maxima of stars of Group II. is general. The period is given by Gore as 256 days, and the range as from 7.5-8.5 at maximum to < 12.2 at minimum. The maximum will occur on February 24.

A. FOWLER.

SPECTRUM OF THE ZODIACAL LIGHT.—In this month's *Observatory*, Mr. Maxwell Hall gives the results of a series of observations of the zodiacal light made at Jamaica. The observations are divided into three groups, according to the angular distance from the sun of the part of the zodiacal light observed. With respect to the first group, made at a distance of 50° from the sun, it is noted that the spectrum was seen as a faint white continuous band, commencing suddenly at λ 561, and extending as far as G, where it died out very gradually. The limit was well determined by comparison with the carbon flutings at λ 470, 517, and 564. The result of the second group of observations, made at a distance of 22° from the sun, showed that the spectrum commenced at λ 561, but not so suddenly; its feeble maximum was transferred to about λ 517; from thence it was tolerably uniform to about λ 497, and then it gradually diminished and faded away at G.

The observations made at a distance of 15° from the sun gave λ 562 for the limit of the red end of the spectrum, and G as before for the violet end. But the spectrum did not commence at all suddenly: the stronger maximum was still at λ 517: it was fairly uniform from thence to λ 497, and then faded away.

Observations of twilight are needed to determine whether, as it grows more and more faint, the maximum appears to shift towards the red end of the spectrum or not; if not, the change in intensity of portions of the spectrum of the zodiacal light as observations are made at varying distances from the sun are peculiar to it, and need further investigation.

SOLAR AND STELLAR MOTIONS.—Prof. J. R. Eastman, in his address as retiring President of the Philosophical Society of Washington, delivered December 7, 1889, gave an exhaustive account of the investigations that have been made to determine the co-ordinates of the solar apex and the annual value of the motion of the solar system. His investigations into the relation between stellar magnitudes, distances, and motions, show that, in opposition to the assumption generally accepted, which asserts that the largest stars are nearest the solar system, there is an almost uniformly *increasing* proper motion as the stars grow fainter. Forty-six stars, that is, practically all those whose parallaxes have been well determined, have been tabulated and arranged in five nearly equal groups according to the magnitude of their proper motion. The following table gives the mean results found for each of the groups:—

	Number of Stars in Group.	Mean Magnitude.	Mean Proper Motion.	Mean Parallax.
1st Group	9	5.57	4.93	0.32
2nd "	9	5.59	2.33	0.20
3rd "	9	3.37	1.04	0.20
4th "	9	2.36	0.38	0.16
5th "	10	2.84	0.06	0.13

The mean magnitude of the first two groups is 5.58, and the mean proper motion is 3.63. Of the last three groups the mean magnitude is 2.86, and the mean proper motion is 0.49.

If the 46 stars investigated be arranged according to the magnitude of their parallaxes, it is found that 18 of them have a parallax greater than 0.2. The mean magnitude of these stars is 5.56, and the mean parallax is 0.34. Of the remaining 28 stars the mean magnitude is 2.89, and the mean parallax is 0.11. From this it would appear that, if any law can be formulated from the observed data, it must be that the fainter rather than the brighter stars are nearest the solar system.

DUN ECHT OBSERVATORY.—The Earl of Crawford, in a circular issued on the 29th ult., expresses his thanks for the hearty co-operation he has met with at all hands in his endeavours to advance the science of astronomy. Although some little time will elapse before all the instruments can be removed from Dun Echt to the Royal Observatory at Edinburgh, the former observatory must be looked upon as closed, and the generous donor trusts that the astronomical friends who have for years continued to enrich the library at Dun Echt Observatory with donations of books and pamphlets will extend their liberality

to the new home of the collection at Edinburgh. The important astronomical work done by the Earl of Crawford personally, and at his observatory, has contributed, in no slight degree, to the progress of astronomy, and the very generous gift to the nation of the entire contents of the observatory at Dun Echt is worthy of the man, and appreciated by all friends of the science throughout the world.

MELBOURNE OBSERVATORY.—We have received from Mr. Ellery the volume containing the results of transit circle observations made from the beginning of 1881 to the end of August 1884. The separate results for R.A. and N.P.D. have been taken directly from the transit books, and also the observer's estimates of the magnitude. The places and magnitudes of the stars given in the annual catalogues have been derived from these separate results by taking their arithmetical mean.

GEOGRAPHICAL NOTES.

At the meeting of the Royal Geographical Society on Monday, Mr. Douglas W. Freshfield read a most interesting paper on "Search and Travel in the Caucasus: an account of the discovery of the fate of the party lost in 1838." He began by acknowledging his obligations to M. de Stael, the Russian Ambassador to the Court of St. James's, the officials at Vladikavkaz, and more particularly to MM. Jukoff and Bogdanoff, of the Russian Survey, for the facilities and assistance given to him and his companions in carrying out the object of his journey. The topographical information accumulated by the surveyors had been placed at his disposal with the greatest readiness, and part of the result might be seen in the great map (6 inches to the mile) of the central group hung on the wall. The heights of the principal peaks were now ascertained. There were eight higher than Mont Blanc, and fifteen of over 15,000 feet. The four highest are Elbruz, Koshtantau, Shkara, and Dychtau. Ushba is 15,600 feet. Mr. Freshfield briefly described the new carriage pass, the Mamison, 9400 feet, from Vladikavkaz to Kutais. Its scenery is finer than that of the Dariel, and the road has been well engineered, but it will shortly fall into ruin unless a service is organized for its maintenance. He referred to the remarkable old Ossete sanctuary of Rekom, at the foot of the Ceja Glacier, and to the tombs found at Chegem, and exhibited a collection of metal and other objects discovered mostly at Styr Degir. In many villages small settlements of "Mountain Jews" were found. There were over 20,000 of this race in the Caucasus, and a work on them has lately been published at Moscow. The author, M. Mirimissoff, states that their beliefs and superstitions are singular, and show Persian influence, but they have had for centuries no connection with the rest of their race, from which they were probably separated at a very early date. The party had crossed five high glacier passes before reaching Suanetia. Here Mr. Freshfield and Captain Powell were the guests of Prince Atar Dadish Kilia, the representative of the family who once ruled Lower Suanetia. He now spends a few months in the summer at his house at Ereri, dispensing hospitality in feudal fashion among his retainers. The population assembles every Sunday for games on the green, and the women sing ballads recounting incidents in local history or tales of love and revenge. The Leila peaks (13,400 feet) south of Suanetia were ascended for the first time. They are pre-eminent in forests and flowers. One of the glaciers falls over a cliff in avalanches into a glen which is a bed of wild roses and yellow lilies, growing often with fourteen blooms on one stalk. From Suanetia to Sukhum Kaleb the travellers forced a way with mules through an almost trackless forest, and down the deserted valley of the Kodor, the region that was once Abchasia. Strange tales are told of the forest, even by Russian officials, who declared that a wild race, without villages, arms, or clothes, haunted its recesses. No one was met, however, but a few hunters and shepherds. But considerable difficulty was met with in forcing a way through the tangle of fallen timber and finding a passage over the torrents, and the native guides employed deserted the travellers before they reached Lata, the first Russian station on the Kodor. Mr. Freshfield proceeded to relate in detail the incidents of the search undertaken by Mr. C. Dent and himself, with the aid of Mr. H. Woolley and Captain Powell, for traces of the fate of the mountaineers, Mr. W. F. Donkin, Mr. H. Fox, and two Meiringen guides, lost in August 1838. It was known, from a note in a diary left by Mr. Fox in a lower

camp with his heavy luggage, that the lost party had set out from the Dumala Valley in the Bezingi District, with the hope of climbing Dychtau, 16,880 feet, from the south-east. Karaoul, at the head of the Cherek Valley, was made, therefore, the headquarters of the search party. They bivouacked under a rock beside the Tutuin Glacier, at a height of 9400 feet. Next morning (July 29) they started at dawn, and forced, not without difficulty, a passage through the monstrous *seracs* of the Tutuin Glacier. Above them they found a long snowy corridor leading to the base of Dychtau, and to the foot of a gap in its east spur, which they believed Mr. Donkin and his companions had crossed from the Dumala glen on the further side. Nothing was found at the foot of the steep rock wall, 1400 feet high, which protected the pass. The searchers therefore climbed the rocks leading to it, and when 1000 feet above the snow and some 400 below the ridge, the traces sought were met with. The leader at the rope's end suddenly stopped short and gasped, "See, here is the sleeping-place." Before our eyes rose a low wall of loose stones built in a semicircle convex to the lower precipice. A crag partially overhung it; any object dropped over the wall fell 1000 feet on to the snow plain below. The space, some 6 feet square, inside the wall, was filled with uneven snow or ice, from which portions of knapsacks and sleeping bags protruded. A black stew-pan, half full of water, in which a metal cup floated, lay against the rock; a loaded revolver was hung beside it. It cost more than three hours' hard work to dig out all the objects from the frozen stuff in which they were embedded. Only three could work at once in the narrow space, and Mr. Freshfield and Mr. Woolley went on to the ridge, where they found a small stoneman, but no written record. Some manuscript notes and maps of Mr. Fox's were found in the bivouac, but nothing written after leaving the lower camp. The whole of the cliff and cliff's foot were carefully searched with a strong telescope. Mr. Woolley and his guides twice passed along the cliff's foot on his ascent of Dychtau, and he made certain that the party had not climbed the peak—that the accident therefore had happened on the ascent. After the lecture, Mr. Freshfield showed in the lantern a series of views of the Caucasus, from photographs by Mr. Hermann Woolley and Signor V. Sella. A complete set of Signor Sella's views, embracing eight panoramas and 90 views, was shown in an adjoining room. The panorama from Elbruz shows the whole chain of the Caucasus above a sea of clouds, and is probably the finest mountain photograph yet exhibited.

THE last issue of the *Izvestia* of the Russian Geographical Society is more than usually interesting, as it contains detailed letters received from the members of the three Russian expeditions now engaged in the exploration of Central Asia. The letter of M. Roborovsky, dated August 16, and written in the highlands to the south of Yarkend, contains a most vivid description of the journey from the town Prjevalsk to Yarkend, across the passes of Barskaun and Bedel. M. Roborovsky knows Central Asia well, as he was Prjevalsky's travelling companion during three of his great journeys; and his descriptions of the country—its orography, climate, and flora—are full of most valuable information. Another letter is from M. Bogdanovitch, the geologist of the expedition, who joined it at Yarkend, after having crossed the Kashgarian Mountains on another route and explored the Mustagh-ata glaciers. That part of the Pamir border-ridge had already been explored by Stoliczka, but M. Bogdanovitch adds much new information. It appears—as might have been expected from the orography of the region—that there is no trace of mountains running north and south on the eastern edge of the great Pamir plateau. The Kashgar Mountains are an upheaval of gneisses, metamorphic slates, and Tertiary deposits, running from north-west to south-east. The limestones which Stoliczka supposed to be Triassic, proved to be Devonian. The most characteristic fossils of the Upper Devonian (*Atrypa reticularis*, *A. latilinguis*, *A. aspera*, *Spirifer Vermeuli*, and several others) were found together with the corals (*Lithodendron*), *Stromatopora* and *Cerriopora* described by Stoliczka. The Tertiary sandstones are broken through (as is often the case in Siberia) by dolerites of volcanic origin, at the very border of the plateau, on its slope turned towards Kashgaria. Another series of letters, the last of which is dated September 23, from the sources of the Aksu, is from Colonel Grombchevsky. The late spring delayed the advance of the expedition, which spent the first part of June in crossing the Alai Mountains. The great Alai Valley of the Pamir could be reached only on June 19, but the Trans-Alai Mountains were buried in snow; no passage was

possible, and the explorer was compelled to march to the lower tracts of Karategin. He thence proceeded to Kala-i-khum, a little town situated on the Pendj, at a height of 4500 feet, and enjoying a relatively mild climate. From Kala-i-khum M. Grombchevsky succeeded in reaching the Vantcha river; but having met there the Afghan troops which were taking possession of the khanates of Shugnan and Rothan, he could not move further south, nor explore the western parts of the Pamir; so he proposed to continue the exploration of the eastern parts of the Roof of the World. Finally, the two brothers, Grum-Grzimailo, who are exploring the Eastern Tian-Shan from Kuldja to Urumtsi, give short news of their progress, and remark that our maps of Eastern Tian-Shan are quite incorrect—a circumstance which might have been guessed from the general orographical structure of Central Asia. The collections of vertebrates and insects which have been gathered by the two explorers are exceedingly rich.

A PERMANENT Marocco museum is to be established at the head-quarters of the Society of Commercial Geography at Berlin.

SMOKELESS EXPLOSIVES.¹

II.

SO far as smokelessness is concerned, no material can surpass *gun cotton* pure and simple; but, even if its rate of combustion in a firearm could be controlled with certainty and uniformity, although only used in very small charges, such as are required for military rifles, its application as a safe and reliable propulsive agent for military and naval use is attended by so many difficulties, that the non-success of the numerous attempts, made in the first twenty-five years of its existence, to apply it in this direction, is not surprising.

Soon after its discovery by Schönbein and Böttger in 1846, endeavours were made to apply gun-cotton wool, rammed into cases, as a charge for small arms, but with disastrous results. Subsequently von Lenk, who made the first practical approach to the regulation of the explosive power of gun-cotton, produced small-arm cartridges by superposing layers of gun-cotton threads, these being closely plaited round a core of wood. Von Lenk's system of regulating the rapidity of burning of gun-cotton, so as to suit it either for gradual or violent action, consists, in fact, in converting coarse or fine, loosely or tightly twisted, threads or rovings of finely carded cotton into the most explosive form of gun-cotton, and of arranging the threads or yarns in different ways so as to modify the mechanical condition, *i.e.* the compactness and extent and distribution of enclosed air-spaces, of the mass of gun-cotton composed of them. Thus, small-arm cartridges were composed, as already stated, of compact layers of tightly-plaited, fine gun-cotton thread; cannon cartridges were made up of coarse, loose gun-cotton yarn wound very compactly upon a core; charges for shells consisted of very loose cylindrical hollow plaits (like lamp wicks), along which fire flashed almost instantaneously; and mining charges were made in the form of a very tightly twisted rope with a hollow core. While the two latter forms of gun-cotton always burned with almost instantaneous rapidity in open air, and with highly destructive effects if they were strongly confined, the tightly wound or plaited masses burned slowly in air, and would frequently exert their explosive force so gradually when confined in a firearm as to produce good ballistic results without appreciably destructive effect upon the arm. Occasionally, however, in consequence of some slight unforeseen variation in the compactness of the material, or in the amount and disposition of the air-spaces in the mass, very violent action would be produced, showing that this system of regulating the explosive force of gun-cotton was quite unreliable.

Misled by the apparently promising nature of the earliest results which von Lenk obtained, the Austrian Government embarked, in 1862, upon a somewhat extensive application of von Lenk's gun-cotton to small arms, and provided several batteries of field guns for the use of this material. The abandonment of these measures for applying a smokeless explosive to military purposes soon followed upon the attainment of unsatisfactory results, and was hastened by the occurrence of a very destructive

¹ Friday Evening Discourse delivered by Sir Frederick Abel, F.R.S., at the Royal Institution of Great Britain, on January 31, 1890. Continued from p. 330.