GLACIAL ACTION IN SOUTH AMERICA.

From Professor Agassiz's late report from the Hassler expedition to the Superintendent of the Coast Survey, we learn that his attention has been specially occupied with the glacial phenomena of the regions explored, and that his discoveries in this direction are of a most interesting character.

His observations, which extended along the coast of South America from Monte Video on the Atlantic side to Talcahuano on the Pacific coast, were more particularly directed to the situation and distribution of erratic pebbles and boulders, with the view of determining the agency by which they have been transported to their present resting places. It will be impossible in this article to follow our author step by step through all the very interesting details of his investigations, but, remarking that they have been most thoroughly pursued throughout, we will endeavor to give a brief general idea of their nature and results.

All over eastern Patagonia, including a portion of the straits of Magellan, are horizontal beds of tertiary formation which rise one above another. In consequence of disintegration, the harder beds form retreating shelves, like stairs, upon the slope of the shore, and wherever surface denudation has taken place, these shelves give rise to terraces which stretch, horizontally, at various hights all over the plains. The upper part of a cliff, situate at Cliff End in San Mathias Bay, which has not suffered denudation, was found to consist chiefly of sandy clay, with which alternate two distinct horizontal beds of considerable thickness formed entirely of pebbles. It is noteworthy that while these pebbles alternate thus in regular stratification in the upper part, they also form superficial deposits on the shelves below; and the Professor thinks that similar superficial deposits on such shelves elsewhere may have been mistaken by Darwin in some cases for indications of successive upheavals of the land. Here he sees no evidence of any upheaval, except one, which has taken place since the deposition of the tertiaries, and while shells found therein (now living) already existed; and still less does it appear to him that the country was submerged during the transposition of the erratics found here. Towards the west end of the bay, at San Antonio, where extensive denudations have taken place in the very formation just described, similar pebbles occur again; but, instead of being in well defined beds above the sea level, they exist as shore pebbles, which cover, in a deep layer, the entire beach. Their position here shows, beyond doubt, that the set of beds above which they rest at Cliff End has been broken down and recently removed by the action of the sea, and the pebbles themselves thus brought down to the beach. It follows from this that they could not have been ground to their present shape upon the modern beach, but that they must have undergone that process upon an older foundation which corresponded at the time to the level of their beds at Cliff End.

From these facts, and from subsequent observations relative thereto made farther south, the inference is drawn that these pebbles must have passed through the mill of a glacier's bottom before they were worked up by the floods into their present position; and there is no reason why the floods which denuded the shelves could not as well have been caused by melted ice at the close of the glacial period, as by a change of level between land and sea.

In Possession Bay, in the Straits of Magellan, was found, about a mile from the shore bluff and nearly 150 feet above the sea level, a salt pool, in which marine shells identical with those now living along the shore were abundant. They were perfectly preserved and many of them were alive. In this was evidence of a very recent upheaval, and a confirmation of Darwin's assertions of recent occurrences of a like nature on this shore. Upon further exploration, upon a tertiary terrace a little above the salt pool was found a distinct moraine (that is, a ridge of boulder-shaped stones always found at the foot of a glacier) in which scratched pebbles were mingled with rounded ones in as large a proportion as occurs in any moraine found fronting an existing glacier. Higher up, also, erratics were scattered over the plain, and at the highest elevation, 400 feet above tide water, a number of large, angular boulders were seen. The existence of this pool and moraine, in close proximity, is considered a fact of great significance. That no gradual upheaval has occurred is proved by the ground, which consists of tertiary beds without a trace of shore pebbles. Darwin was led to believe that the drift was scattered over Patagonia by icebergs while the country was submerged; but the presence here of this moraine shows that the upheaval must have occurred before the dispersion of the drift, and not after.

Many and almost exact similarities were remarked between the Patagonia and Alpine scenery, and the surface features of the straits were found to have much the same aspect as the glaciated surfaces of the northern hemisphere, while from the higher mountains of the Andes glaciers were seen, depending to the sea level, which may fairly be compared with the most impressive glaciers of the Alps. In many places the glacial marks were as plain as in the valleys of Switzerland, and the abrasion by ice was uniform, general and unmistakable. The grand general movement appears to have been from the south, northward; and the direction is such that glaciers from the adjoining mountains cannot be supposed to have caused the abrasions and furrows of the rocks.

All the erratic stones found in the entire survey possess the same character, and their geological identity is further shown by the presence of a certain very hard, compact rock which is never absent from them, and yet never found in place, so far as known, over the whole extent of country examined. Their present position therefore cannot have been due to the enlargement of the existing glaciers, as in that case the drift would consist mainly of the rocks in place and would differ according to locality. This distinctive nature of the drift led our author from the first to discriminate between the phenomena connected with the local glaciers and those belonging to what he designates the glacial period. To this period he refers a great part of the phenomena witnessed by him, and which he looks upon as palpable evidence that a prodigious mantle of ice was once spread over the southern part of this continent; and he further believes that future investigation will bring to light conclusive evidence of a southern circum-polar glacial agency.

Recent Astronomical Discoveries.

Dr. Huggins has communicated to the Royal Society a series of results of extreme interest, obtained by means of the fine telescope placed at his disposal by the Royal Society.

His work, according to the *Mechanics' Magazine*, has been divided into two main portions. First, he has been engaged in comparing one of the bright spectral lines of the gaseous nebulæ with the corresponding line in the spectrum of nitrogen. This line, as seen in the latter spectrum, is double. When using his own 8 inch telescope, Dr. Huggins was unable to determine whether the nebula line was double or not. He could not use sufficient dispersive power. He has now obtained definite results on this point, so far at least as the Orion nebula is concerned. In the spectrum of nitrogen, the components of this double line are rather broad and nebulous. In the spectrum of the Orion nebula, there is one line, narrow and well defined, which agrees in position with the less refrangible of the nitrogen pair.

It is possible, however, Dr. Huggins remarks, that this line in the spectrum of the gaseous nebulæ is not due to nitrogen at all; or else, one line of nitrogen fades out altogether.

The second series of results obtained by Dr. Huggins is more definite and important. It relates to the determination of the stellar motions of recession or approach.

Dr. Huggins had judged, when he used his 8 inch telescope, that Sirius is receding at the rate of about 25 miles per second. He now finds, with a telescope fifteen feet long, that the rate of recession is somewhat less, lying probably between 18 and 22 miles per second.

He has now been able to extend this method to several other stars. He finds evidence in favor of a general tendency to recession in stars occupying that part of the heavens from which our sun is known to be traveling; while on the opposite side of the heavens the stars seem in general to be approaching. But the rates of recession and approach accord very ill with the usually adopted value of the solar proper motion, and appear to support the theory, recently advanced, that the estimates of the stellar distances, on which that value has been based, are not trustworthy. We know that the sun's rate of motion has been set at five or six miles per second, and such a rate of motion could only account for a general excess of recession in stars lying in one direction, and of approach in stars lying in the opposite, by about the same amount. But Dr. Huggins finds motions of recession of from 15 to 40 miles per second, and motions of approach amounting even to the enormous rate of nearly 50 miles per second, in the case of Arcturus. It follows from this that Struve's estimate of the average distances of the brighter stars is altogether too low.

But even more interesting than this result, is Dr. Huggins's recognition of a community of motion in certain sets of stars.

It was to precisely such community of motion that Mr. Proctor invited attention in the paper on star drift, read before the Royal Society on January 20, 1870; and he expressed then, and has since repeatedly expressed, his conviction that whenever Dr. Huggins applied to certain stars the spectroscopic method of determining motions of recession or approach, he would find that they are either all receding or all approaching, and at the same rate.

This prediction has been fulfilled to the letter. Dr. Huggins finds that these stars are all receding at the rate of about 30 miles per second.

It is evident that Dr. Huggins' method of research promises results of exceeding interest and throwing a new light on the structure of the sidereal universe. He has now placed beyond question what Mr. Proctor has long maintained—the theory, namely, that within the stellar system there exist subordinate systems, surrounded by regions relatively barren. These systems of stars speed on their course, possessing a community of motion within the great star system, though within these subordinate systems themselves every variety of motion may subsist. It is wonderful, indeed, to consider the consequences which flow from this discovery. The whole aspect of the sidereal universe is changed by it. All theories which have so long done service in our text books of astronomy go by the board. We see that there is a complexity of detail within the stellar universe and a variety of aggregation, of structure, of motion, of interdependence, and finally, an exuberance of vitality, such as until the last two or three years had not been recognized by astronomers.

Compressed Gun Cotton.

Great benefits in point of economy and efficiency are derived from the new system of reducing the gun cotton fiber to pulp, and converting it by powerful compression into compact homogeneous masses. Important consequences of the large reduction in the space occupied by gun cotton, when used in this compressed form, were the very considerable increase in the amount of tamping which could be used in blast holes, and the greater concentration of the force applied; the destructive effects in hard rock were consequently much augmented, and the coal blast should be placed farther apart and reduced in dimensions. Large charges of compressed gun cotton occupied so much less space than the rope charges, and were so considerably lighter than powder charges, that the material became specially valuable for submarine operations. Other peculiar advantages were presented by the compressed material; thus, its cost of production was greatly reduced, because cotton waste could be employed in its manufacture, and because its conversion into the required forms required comparatively little time: its purification was more complete, as the finely divided fiber was much more readily washed than the long fiber required for furnishing rope charges; and its uniformity was much greater, because the products of a large number of successive small operations were intimately blended together in the pulping and washing processes.

When carried into the field for military purposes, compressed gun cotton is very decidedly safer than nitro-glycerin preparations; because if carts or packages containing the latter are fired into from accident or design with ordinary small arm bullets, their contents will be violently exploded as by detonation, while the gun cotton under the same circumstances would be simply inflamed.

Although gun cotton and nitro-glycerin mixtures possess very important advantages over gunpowder, in all applications where suddenness and violence of action are desirable, there are some directions in which they do not possess superiority over powder, and others in which they cannot replace it, irrespectively of its applications to projectile purposes. In soft rock, in earth mines, and in some blasting operations, where it is desired to displace large masses of earth, rock, or stone, the gradual action of gunpowder gives it decided superiority.

The degree of safety with which explosive agents may be manufactured is an important question connected with their extensive application. The fact that the manufacture of gun cotton as now carried on involves not the slightest risk of explosion up to the final stage, when the material has to be dried, distinguishes it from most other explosive agents. In gunpowder manufacture, liability to explosion exists throughout all operations from the point when the ingredients are mixed, and with regard to nitro-glycerin it appears that up to the present time occasional severe accidents during manufacture have been inevitable. The immunity enjoyed by gun cotton is due to its being wet, and therefore absolutely uninflammable, throughout all stages, even after it has been compressed into cakes or disks. At this point it contains 15 per cent of water, the expulsion of which by desiccation is unattended by any liability to explosion, or even to ignition if very simple precautions are adopted. For storing large quantities with absolute safety, it is very convenient to preserve the compressed gun cotton damp, as it is delivered from the presses. It has been thus stored for very long periods without the slightest detriment, and its non-inflammability in this condition is aptly illustrated by the fact that the perforations required in some of the charges are produced by drilling the damp gun cotton, the drill revolving at the rate of about 600 revolutions per minute. The gun cotton employed in some extensive experiments recently made had been stored damp for nearly nine months, and was dried partly in the open air and partly in a hot air chamber, when required for use. On that occasion, says the *Mechanics' Magazine*, six cwt. of damp gun cotton, packed in 24 strong wooden boxes, were stacked in a wooden shed and surrounded by inflammable material. The building was then fired, and soon burned fiercely, which it continued to do for about half an hour, when the fire gradually subsided, and the building and its contents were entirely consumed. The gun cotton must have slowly burned away as the surfaces of the masses became sufficiently dry, but at no period of the experiment was there even any burst of flame, due to rapid ignition, perceptible.

Narrow Gage in Japan.

After three years' labor, the Japanese have succeeded in building one railroad for a distance of thirteen miles. The line was intended to connect Yokohama and Jeddo, these cities being seventeen and a half miles apart; but public travel has already begun upon it, in spite of its unfinished condition.

The road has but a single track of three feet six inches gage, and yet has cost nearly $120,000 per mile. Unless, as is most probably the case, there is an immense lack of engineering talent in the country, it is difficult to find an explanation for this state of facts. Labor is abundant and cheap; money and material are plentiful, and the construction of the line has been retarded by no physical difficulties.

The correspondent of the New York *Herald* states that even the completed portion of the route is but poorly built, notwithstanding its great cost. There are first, second, and third class cars. Those of the lowest class look like diminutive cattle cars with wooden benches in them, while those of the other classes resemble ordinary street cars, only they are narrower and in every way smaller. The first class cars are divided into three compartments by sliding doors, and carry twelve persons comfortably. The second class cars differ from the first by not being subdivided, and by being furnished with cane seats instead of leather ones.

The highest speed attained is about twenty-two miles per hour. Officials abound, there being two to each car. The road, in spite of all its shortcomings, is rapidly making money, having averaged since its opening some $500 per day. The rates of fare are absurdly high (1st class, $1·50; 2d class, $1; 3d class, 50 cents); but these, it is stated, will soon be reduced.

THE great bridge across the Mississippi at St. Louis, Mo., is almost done. It is to be finished during the present month of August.