President, and were expressly manufactured for the purpose by Mr. Mitchell, of Caleneck in Cornwall. In order to prevent the reduction of any portion of the lead entering into the composition of the glass, a current of fresh air was introduced by a tube, and made to pass along the surface of the fused glass. A very minute and circumstantial account is given of all the manipulations necessary for conducting these processes in all their stages; in some of which, however, the best methods of proceeding still remain to be ascertained, variations having been made up to the very last experiment, and it is only by still more extensive experience that the author expects the proper arrangements will ultimately be settled. Directions are given as to the occasional inspection of the glass during the process, the mode of stirring by a rake of platina, and the plan devised by the author of accelerating the disengagement and escape of bubbles, by throwing into the melted materials a quantity of pulverized platina, mixed with fragments of the same kind of glass. The glass which has been obtained by the mixture of materials above mentioned, constituting silicated borate of lead, has a specific gravity of 5·44, and high refractive and dispersive powers, and perhaps also very considerable reflecting power.—It is softer than ordinary glass, but less liable to be tarnished by sulphureous vapours, as they commonly exist in the atmosphere; and also less acted upon by moisture than glass, in which potash enters as an ingredient; it is also a much more perfect electric than ordinary glass. An Appendix is subjoined, containing descriptions of the rough glass furnace, and the finishing furnace; and also directions for preparing the spongy platina employed by the author in the latter stage of the process, in order to promote the disengagement of bubbles.

Account of Levellings carried across the Isthmus of Panamá, to ascertain the relative Height of the Pacific Ocean at Panamá, and of the Atlantic at the mouth of the River Chagres; accompanied by Geographical and Topographical Notices of the Isthmus. By John Augustus Lloyd, *Esq. Communicated by Captain* Sabine, *Sec. R.S.* Read November 26, 1829. [*Phil. Trans.* 1830, *p.* 59.]

The author having received from General Bolivar a special commission to survey the Isthmus of Panamá, with the view of ascertaining the most eligible line of communication between the two seas, arrived at Panamá in March 1828. Here he was joined by Captain Falmarc, a Swedish officer of Engineers, in the Colombian service. Anxious to lose no time in the prosecution of their objects, they proceeded on the 5th of May to commence their operations, resolving not to be deterred by the difficulties likely to arise from the rainy season, which had just set in, from personal privations, and even from the dangers to which they might expose their health. Their line of survey commenced at Panamá, and was continued along the old road to Porto Velo till it came to the bed of the Chagres, a river which falls into the Gulf of Mexico. The greatest height

passed over in this line was 633·32 feet above the level of high water at Panamá. Their constitutions were now beginning to suffer from the continued exposure to rain, and they therefore determined, after building a secure station on the banks of the Chagres, to defer all future operations till the ensuing year, when the dry season should be established. On the 7th of February, 1829, they resumed their labours, carrying on their levels from a point of the river below their former station, and 152·55 feet above high-water mark at Panamá, along the course of the river to a place distant about 12 miles from its mouth, called La Bruja, where the water in dry seasons is very brackish, and from which there is no perceptible current to the sea.

The result of this survey fixes the mean height of the Pacific, at Panamá, at 3·52 feet above the Atlantic at Chagres. Between the extremes of elevation and depression of the greatest tides in the Pacific at Panamá, there is a difference of 27·44 feet; but the mean difference at the usual spring tides is 21·22. At Chagres, this difference is only 1·16 foot, and is the same at all seasons of the year. Hence it follows, that at high water, the time of which is nearly the same on both sides of the Isthmus, the Pacific is raised, at mean tides, 10·61 feet, and the Atlantic 0·58 foot, above their respective mean levels, giving to the former an elevation above the latter of 13·55 feet. At low water, both seas being below their respective mean levels, by the same quantities as before stated, the Pacific will be lower than the Atlantic by 6·51 feet; so that thus, in the course of every interval from one high tide to the succeeding one, the level of the Pacific is at first higher, then equal, and afterwards lower than the Atlantic; and then again passing back by the same steps it regains its former elevation as the tide returns.

The great chain of mountains which extends from the Andes in South America to the Mexican and Rocky Mountains in North America, is not, as is generally supposed, absolutely continuous through the Isthmus connecting these two continents; for the northern Cordillera on the eastern side of the province of Veragua, breaks into detached mountains of considerable height, having steep and rugged sides. To these succeed numerous conical mountains, rising from plains and savannahs, and seldom exceeding from 300 to 500 feet in height. Between Chagres on the Atlantic side, and Chorrera on the Pacific, the conical mountains are less numerous, and are separated by extensive plains, with only a few occasional insulated hills of inferior extent and elevation. Thus it happens that at the narrowest part of the Isthmus, a break occurs in the mountain-chain, which, in almost every other part, is uninterrupted from its northern to its southern extremities; a circumstance which marks this spot as peculiarly adapted for the establishment of a communication across. The author has laid down on his map two lines for a rail-road, both commencing at a point near the junction of the river Trinidad with the Chagres, and crossing the intervening plain, the one to Chorrera, the other to Panamá. The latter line, although the longer of the two, would have the advantage of terminating in a considerable city.

The banks of the river Trinidad are represented by the author as being well suited for wharfs, especially in the neighbourhood of the spot he recommends as the commencement of a rail-road; but as the mouth of the Chagres is impeded by a bar, he suggests the expediency of forming a communication with the adjacent Bay of Limon, which, in its present state, affords excellent anchorage, and which, by making certain improvements in it, pointed out in the paper, might, at a small expense, be rendered one of the most commodious and safe harbours in the world.

On the Law of the partial Polarization of Light by Reflexion. By David Brewster, *LL.D. F.R.S. L. & E.* Read February, 4, 1830. [*Phil. Trans.* 1830, *p.* 69.]

When a beam of ordinary light is incident upon the surface of a non-metallic body, at an angle having a certain relation with its refractive density, the portion which is reflected is found to be completely polarized in the plane of reflexion; but when the angle of incidence is either greater or less than this, which is the polarizing angle, the polarization is incomplete, as is proved by transmitting the reflected beam through a doubly-refracting crystal, which decomposes it into the ordinary and extraordinary rays. What a single reflexion is unable to effect, may, however, be accomplished by a sufficient number of successive reflexions at angles different from the polarizing angle. The author had pointed out this fact in his communications to the Royal Society in the year 1815; and the further investigation of the law on which this phenomenon depends, has led him to the discovery of the real change effected in light by its reflexion, and opened new views of that condition which constitutes its polarization. The prevailing notion with regard to the condition of the light which has been imperfectly polarized by reflexion, has been, that it consisted of two portions; the one wholly polarized in the plane of reflexion, and the other not changed, but still retaining the character of natural light. This doctrine was supported by Young, Biot, Arago, and Fresnel, and more recently by Herschel. Dr. Brewster contends, in opposition to these authorities, that every portion of the reflected beam has suffered a physical change by the action of the reflecting forces, some being completely polarized, others only partially so; complete polarization consisting in the effecting of such a change in the position of the plane of polarization, as that they shall be parallel to the plane of reflexion; partial polarization, on the other hand, consisting in these planes being only brought nearer to this position of parallelism. In order to simplify the investigation, the author begins by considering the case of a beam of light composed of two polarized pencils, of which the respective planes of polarization are at right angles to each other, which two pencils may be conceived to be superposed upon each other. He then shows that the phenomena exhibited by this compound pencil are exactly the same as those exhibited by common or unpolarized light. He next proceeds