an internal radius of 5∙9 inches (15cm), and lighted by a lamp of one wick, or Argand burner, consuming 48 gallons of oil per annum.

The four orders, as already hinted above, and explained by M. Fresnel in his observations prefixed to the list of the French lights for 1833, are not intended as distinctions ; but are characteristic of the power and range of lights, which render them suitable for different localities on the coast, ac­cording to the distance at which they can be seen. This di­vision, therefore, is analogous to that which separates our lights into *sea-lights, secondary lights,* and *harbour lights,* terms which are used to designate the power and position, and not the appearance of the lights to which they are applied.

Each of the above orders is susceptible of certain com­binations, which produce various appearances, and consti­tute the distinctions used for dioptric lights; but the follow- ingare those which have been actually employed as the most useful in practice :—

The first order contains, l*st*. Lights producing great flashes, preceded by smaller ones, once in every minute, by the revolution of eight great annular, and eight smaller len­ses, as at Corduan ; 2*d*. Lights flashing once in every half minute, and composed of sixteen half lenses. These lights may have the subsidiary parts simply catoptric, as at Biar­ritz, or dia-catoptric, as at Planier ; and, *3d.* Fixed lights, composed of a combination of cylindric pieces, with mir­rors ranged in tiers above and below them as at the Isle d’Yeu.

The second order comprises revolving lights with sixteen or twelve lenses, which make flashes every half minute ; and fixed lights varied by flashes once in every four minutes, as at Pilier, an effect which is produced by the revolution of exterior cylindrical pieces.

The third order (larger diameter) contains common fixed lights, and fixed lights varied by flashes once in every four minutes, as at Aiguesmortes.

The third order, (smaller diameter,) contains fixed lights, varied by flashes once in three minutes, as at Commerce on the Loire, and common fixed lights, as at Aiguillon, Grave, and Dunkerque.

The fourth order has fixed lights varied by flashes once in every three minutes, and fixed lights of the common kind, as at Pertuis-Breton, and La Coubre. It has been thought necessary to change the term “ fixed lights varied by flashes,” for “ fixed light with short eclipses,” because it has been found that, at certain distances, a momentary eclipse precedes the flash.

These distinctions depend upon the periods of revolution, rather than upon the *characteristic appearance* of the light ; and therefore seem less calculated to strike the eye of a sea­man, than those employed on the coasts of Great Britain and Ireland. In conformity with this system, and in con­sideration of the great loss of light which results from the application of coloured media, all distinctions based upon colour have been discarded in the French lights.

Having thus fully described the nature of the catoptric and dioptric modes of illuminating light-houses, we shall next proceed to compare the merits of both systems, with a view to determine their eligibility in revolving or in fixed lights.

Repeated experiments were made at Gulan-hill, which is distant from Edinburgh about fifteen miles, during the winters of 1832 and 1833. under the inspection of the Com­missioners of Northern Lights, the result of which was, that the light of one of the great annular lenses used in the re­volving lights of the first order, was equal to the united effect of about eight of the large reflectors employed in the revolv­ing lights on the Scotch coast. It may be said, however, that the diacatoptric combination of pyramidal lenses and plane mirrors of Corduan, adds the power of more than two reflec­tors to the effect of the great lens ; but it ought to be remem­

bered that in the French lights, this additional power is used only to lengthen the duration of the flash, and therefore in no degree contributes to render the light visible to the mariner at a greater distance. M. Fresnel found from the smaller divergence of the lens, that the eclipses were too long, and the bright periods of the revolution too short; and he there­fore determined to adopt the horizontal inclination of 7° for the upper lenses, with a view to remedy this defect. As­suming, therefore, that it were required to increase the num­ber of reflectors in a revolving light of three sides, so as to render it equal in power to a dioptric revolving light of the first order, it would be necessary to place eight reflectors on each face, so that the greatest number of reflectors re­quired for this purpose may be taken at *twenty-four.* M. Fresnel has stated the expenditure of oil in the great lamp of four concentric wicks at 750 grammes of oil of colza per hour ; and it is found by experience at the Isle of May and Inchkeith, that the quantity of spermaceti oil consumed by the great lamp, is equal to that burned by fourteen of the Argand lamps used in the Scotch lights. It therefore follows that, by dioptric means, the consump­tion of oil necessary for fourteen reflectors, will produce a light as powerful as that which would require the oil of twenty-four reflectors in the catoptric system followed on the coast of Scotland ; and consequently, that there is an excess of oil equal to that consumed by ten reflectors, or 400 gallons in the year, against the Scotch system. But in order fully to compare the economy of producing two revolving lights of equal power by these two methods, it will be necessary to take into the calculation the interest of the first outlay in establishing them.

The expense of fitting up a revolving light with twenty- four reflectors, ranged on three faces, may be estimated at L.1298, and the annual maintenance at L.418, 8s. 4d. The fitting up a revolving light with eight lenses, and the dia­catoptric accessary apparatus, may be estimated at L.1263, and the annual maintenance at L.280, 10s. 4d. It there­fore follows, that to establish, and afterwards maintain a ca­toptric light, of the kind called *revolving white,* (as that of Start Point in Orkney, where the frame has only three faces,) so as to be equal in power to the dioptric light of Corduan, an annual outlay of L.137∙ 18s. more would be required for the reflecting light than for the lens light; whilst for a light of the kind called *revolving red and white,* (as the Bell Rock or Cape Wrath, where the frame has four faces,) thirty-six reflectors would be required to make the light equal in power to that of Corduan; and the catoptric light would in this case cost L.333 more than the dioptric light.

We shall now speak of fixed lights, to which the dioptric method is peculiarly adapted. The effect produced by the consumption of a gallon of oil in a fixed light, with twenty- six reflectors, like that formerly exhibited at the Isle of May, may be estimated as follows :—The mean intensity of the light spread over the horizontal sector subtended by one re­flector, as measured at each degree by the method of shadows, is equal to that of 174 unassisted Argand burners. If, then, this quantity be multiplied by 360 degrees, we shall obtain an aggregate effect of 62640, which, divided by 1040, the num­ber of gallons burned during a year, by twenty-six reflec­tors, would give *sixty* Argand flames for the intensity of light maintained throughout the year by the combustion of a gallon of oil. On the other hand, the effect of a diop­tric light like that lately established at the Isle of May, may be estimated thus. The mean intensity of the light pro­duced by the joint effect of both the dioptric and catop­tric parts of a fixed light apparatus, may he valued at 376 Argand flames, which, multiplied by 360 degrees, gives an aggregate of 135360; and if this quantity be divided by 570, the number of gallons burned by the great lamp in a year, we shall have nearly 237 for the intensity of light produced by the combustion of a gallon of oil It would