be considered as expedients ; the *numerical plan* hav­ing never once been attempted, though Dr Hooke, De la Bourdonnois, and some others, had long before sug­gested it.

In 1798 a new signal-book was issued by the Admiralty, containing about four hundred sentences, for which flags were appropriated numerically, expressive of certain opera­tions of a fleet, which were sufficiently useful as far as these sentences went ; but when it became necessary to issue any order not to be found among them, the communication was obliged to be made by boats, and “ a boat from each ship” was ordered. The state of the weather did not always ren­der this practicable ; and when it was, men’s lives were fre­quently exposed to imminent risk. To remedy this incon­venience, Sir Home Popham printed at Calcutta a numeri­cal code of naval signals, which was reprinted in England in 1803. He afterwards extended the code very consider­ably, which, by a recommendation of a committee of naval officers, has been adopted, and is now in general use in the navy. The only objection to this code, which more or less applies to all that have subsequently been proposed, is the

great number of flags, &c., required for making numerical signals to the extent as laid down in the code in question ; and which consists of nine flags, five cornettes, five tri­angles, and five pendants. With such a number it is next to impossible to make out, in calm weather, the figure and the colour of the flags ; and equally so when in situations where, though expanded by the wind, they present only an edge to the eye of the observer, when the distance is not too great, so as to sink the hull of the ship behind the cur­vature of the earth. The semaphore or sea-telegraph of Sir Home Popham comes in aid of, and indeed entirely removes, those difficulties. It consists of two posts, with a moveable arm to each (see the article Navy), and may be removed to any part of the deck ; but we are not sure, simple as it is, that the Universal Telegraph of Colonel Pasley, consisting of one post and two arms, might not be adopted with advantage as a sea-telegraph. The former exhibits eight, the latter seven positions. (μ.)

TELEMACHUS, the son of Ulysses and Penelope. His character and adventures belong more to poetry than to history.

TELESCOPE.@@1

Telescope, an optical instrument for viewing distant objects ; so named by compounding the Greek words *τηπε*, *far off,* and *σχοπέω*, *I look at* or *contemplate.* This name is commonly appropriated to the larger sizes of the instrument, while the smaller are called *perspective glasses, spy-glasses, opera-glasses.* A particular kind, which is thought to be much brighter than the rest, is called a *night-glass.*

The history of the invention of the telescope has been given in our article Optics. The theory of the *Astronomi­cal Telescope* will be found in Astronomy (part iv. chap. 4), where two particular constructions of the instrument, viz. that of Professor Barlow and Mr Rogers, are described ; and also the *Dorpat telescope,* of which a figure is there given. At the time that article was written, this was the most powerful instrument of the kind that had ever been directed to the heavens, its object-glass being 91/2 inches in diameter, and focal length about 14 feet. Now, how­ever, the University of Cambridge possesses an instrument still more powerful, the *Northumberland Equatorial,* so call­ed in honour of the noble duke by whom it was presented to the university in the year 1838. The object-glass of this magnificent telescope is 111/2 clear inches in diameter, and its focal length 191/3 feet. A particular description of it has been given in the eleventh volume of the Cambridge Astro­nomical Observations. There is another telescope of still larger dimensions in the possession of an amateur astrono­mer, Mr Cooper of Sligo. The diameter of the object-glass is 13∙3 inches, and the focal length 21 feet 3 inches.

The general aim in the construction of a telescope is, to form, by means of mirrors or lenses, an image of the dis­tant object, as large, as bright, and as extensive as is pos­sible, consistently with distinctness ; and then to view the image with a magnifying glass in any convenient manner. This gives us an arrangement of our subject. We shall first show the principles of construction of the object-glass or mirror, so that it shall form an image of the distant object with these qualities ; and then show bow to construct the magnifying glass or eye-piece, so as to preserve them unimpaired.

This indistinctness which we wish to avoid arises from two causes ; the spherical figures of the refracting and re­flecting surfaces, and the different refrangibility of the dif­ferently coloured rays of light. The first may be called the *spherical* and the second the *chromatic* indistinctness ; and the deviations from the foci may be called the *spherical* and the *chromatic* aberrations.

The limits of a work like this will not permit us to give any more of the doctrine of aberrations than is absolutely necessary for the construction of achromatic telescopes ; and we must refer the reader for a general view of the whole to Euler’s Dioptrics, also to Dr Smith’s Optics. We shall begin with the aberration of colour.

Let white or compounded light fall perpendicularly on the flat side PQ (fig. 1) of a pla­no-convex lens PV Q, whose axis is CV and vertex V. The white ray *p*Pfalling on the extremity of the lens is dis­persed by re­fraction at the point P of the spherical sur­face, and the red ray goes to the point *r* of the axis, and the violet ray to the point *v*. In like manner, the white ray *q*Q is dis­persed by refraction at Q, the red ray going to *r*, and the violet to *v.* The red ray Pr crosses the violet ray Q*v* in a point D, and Q*r* crosses P*v* in a point E ; and the whole light refracted and dispersed by the circumference whose diameter is PQ, passes through the circular area, whose dia­meter is DE. Supposing that the lens is of such a form that it would collect red rays, refracted by its whole surface in the point *r,* and violet in the point *v* ; then it is evident that the whole light which occupies the surface of the lens will pass through this little circle, whose diameter is DE. Therefore white light issuing from a point so distant that the rays may be considered as parallel, will not be collected

@@@, Though this subject has already been partly discussed under the articles Achromatic Glasses and Optics, it could not be viewed as fully illustrated without a separate treatise ; and the editor gladly avails himself of the late Professor Robison’s article on the Telescope, which forms one of the valuable series of contributions by him to the third edition of this work.