ample of such work is the tunnel driven in 1886 by Mr Johnson, the Great Northern Company’s engineer, under the Metropolitan cattle market. Where clear of buildings the tunnel was executed in 12-feet lengths measured from the finished brickwork, the ex­cavation extending another 5 feet. The face of the excavation was carried out in four sections, the first between the head trees and the first sill was formed with a rake of 1 in 4½, the second and third with a rake of 1 in 6, and the fourth was vertical, the whole face being close boarded (see figs. 5 and 6). The arch and side Avails were eight rings and the invert six rings thick. A 12-feet length was completed in 12 to 14 days, and the subsidence in the ground was about 3½ inches. Under buildings and roads the tunnel was executed in 6-feet lengths. The crown bars, 15 inches in diameter, alternating six and seven in number, were built in with solid brickwork in cement and hard wood wedging. The skeleton centres for the arching were supported by props notched into the ribs and provided with wedges for tightening up. A 6-feet length was built in six days, and the surface subsidence, consequent upon the impossibility of exactly fitting the poling boards to the clay, was only from 1 inch to 1¾ inches. Several heavy buildings were tunnelled under without any structural damage arising.

Where open ballast and running sand heavily charged with water are met with a tun­nel cannot be driven on the ordinary sys­tem without seri­ously endangering adjoining buildings. To meet such cases, and also to provide a safe means of tun­nelling under dock basins, canals, and rivers, the pneu­matic shield (see fig. 7) was designed by Mr Benjamin Baker. The shield is supported against external pressure by vertical girders about 6 feet apart. Horizontal shelves of steel plates with cutting edges are spaced about 4 feet apart, and the face of the shield is closed by vertical plates and slides ; the arrangement is such that any slide can be opened to admit of the ballast or sand being excavated, whilst the compressed air filling the tunnel pre­vents the influx of water during the process. Where hard water­tight clay is encountered, sections of the shield plates are unbolted to admit miners. When sufficient material has been excavated the shield is advanced by hydraulic pressure and the brick arching built.

See Aqueduct and Railway; also Drinker’s *Tunnelling,* New York, 1878 (a most important work) ; and *Proc. Inst. Civ. Eng.,* art. “Tunnels.” (B. B.)

TUNNY *(Thynnus thynnus),* one of the largest fishes of the family of Mackerels, belongs to the genus of which the Bonito *(Th. pelamys)* and the Albacores *(Th. albacora, Th. alalonga,* &c.) are equally well-known members. From the latter the tunny is distinguished by its much shorter pectoral fins, which reach backwards only to, or nearly to, the end of the first dorsal fin. It possesses nine short fin- lets behind the dorsal, and eight behind the anal fin. Its colour is dark bluish above, and greyish, tinged and spotted with silvery, below. The tunny is a pelagic fish, but periodically approaches the shore, wandering in large shoals, at least in the Mediterranean, within well-ascer­tained areas along the coast. The causes by which its wanderings are regulated in the Atlantic Ocean are much less understood ; it not unfrequently appears in small com­panies or singly in the English Channel and in the German Ocean, probably in pursuit of the shoals of pilchards and herrings on which it feeds. The regularity of its appear­ance on certain parts of the coasts of the Mediterranean has led to the establishment of a systematic fishery, which has been carried on from the time of the Phoenicians to the present day. Immense numbers of tunnies were caught on the Spanish coast and in the Sea of Marmora, where, however, this industry has much declined. The Sardinian tunnies were considered to be of superior excellence. The greatest number is now caught on the north coast of Sicily, the fisheries of this island supplying most of the preserved tunny which is exported to other parts of the world. In ancient times the fish were preserved in salt, and that coming from Sardinia, which was specially esteemed by the Romans, was known as *Salsamentum sardicum.* At pre­sent preference is given to tunny preserved in oil. Many of the fishes, especially the smaller ones, are consumed fresh. The tunny occurs also in the South Pacific ; but several other species seem to take its place in the Indo­Pacific Ocean. It is one of the largest fishes, attaining to a length of ten feet and to a weight of more than a thousand pounds.

On the tunny fisheries of ancient and modern times, see Cuvier and Valenciennes, *Hist. Nat. des Poissons* (vol. viii. pp. 71-92).

TUNSTALL, a market town of Staffordshire, England, is situated on a branch line of the London and North- Western Railway and on the Trent and Mersey Canal, 4 miles north-west of Stoke and 168 north-west of London. Among the public buildings are the market (1858), town hall (1884), old court-house (now used as a free library and reading room), and board schools (1880). The chief manufactures are those peculiar to the Potteries district ; there are also large iron-works (coal and iron being obtained in the neighbourhood), and brick and tile works. The town is chiefly the growth of the 19th century, and in 1811 numbered only 1677 inhabitants. In 1885 it was included for parliamentary purposes in the borough of Newcastle-under-Lyme. It is governed by a local board of twenty-four members. The population of the urban sanitary district (area 690 acres) was 13,540 in 1871, and 14,244 in 1881.

TURANIAN. This word means etymologically no more than “ not Iranian,” and in this sense the word Turan was used by Sasanian monarchs to cover those parts of their realm that did not belong to Iran. The application of the word to denote the Ural-Altaic family of languages is extremely unfortunate and seems to be falling out of use. See Philology, vol. xviii. p. 779.

TURBINE. See Hydromechanics, vol. xii. p. 524.

TURBOT,@@1 the largest and best known of a genus of flat fishes, *Rhombus,* which bears the appropriate systematic name of *Rh. maximus.* The turbot has great width of body, and is scaleless, but is covered with conical bony tubercles. The eyes are on the left side of the body, the lower being slightly in advance of the upper ; the mouth is large and armed with teeth of uniformly minute size. The turbot is found all round the coasts of Europe (except in the extreme north), preferring a flat sandy bottom with from 10 to 50 fathoms of water. The broad banks off the Dutch coast are a favourite resort. It is a voracious fish, and feeds on other fish, crustaceans, and mollusks. It

@@@1 The word “turbot ” is of great antiquity, perhaps of Celtic origin ; it is preserved in French in the same form as in English, and is com posed of two words, of which the second is identical with the "but" in holibut and with the German “Butte,” which signifies flat fish. The German name for the turbot is “ Steinbutte.”