

considerable fame. In 1735 it was the scene of a severe battle, in which the Austrians were defeated by the Spaniards under Mortemar, in whose honour Philip V. caused a pyramid to be erected on the spot. Population in 1871, 24,978.

**BITSCH** (French, *BITCHE*), formerly *KALTENHAUSEN*, a town and fortress in German Lorraine, on the River Horn, at the foot of the northern slope of the Vosges, between Hagenau and Saargemund. It was originally a countship in the possession of the counts of Alsace and Flanders, but was bestowed by Frederick III. on the dukes of Lorraine, and at length passed with that duchy to France in 1738. After that date it rapidly increased, and its citadel, which had been constructed by Vauban on the site of the ducal palace, was restored and strengthened. The attack upon it by the Prussians in 1793 was repulsed, and although the Bavarians occupied the town in 1815 and 1818, they did not get possession of the fort. In the war of 1870 it was blockaded by the Germans in vain, and only surrendered in 1871, after the campaign was over. A large part of the fortification is excavated in the red-sandstone rock, and rendered bomb-proof; while a supply of water is secured to the garrison by the possession of a deep well in the interior. The inhabitants of the town, who in 1871 numbered 3047, manufacture watch-glasses and matches, and carry on a trade in grain, cattle, wood, and peats.

**BITTERN**, a genus of Wading Birds, belonging to the family *Ardeidae*, comprising several species closely allied to the Herons, from which they differ chiefly in their shorter neck, the back of which is covered with down, and the front with long feathers, which can be raised at pleasure. They are solitary birds, frequenting countries possessing extensive swamps and marshy grounds, remaining at rest by day, concealed among the reeds and rushes of their haunts, and seeking their food, which consists of fish, reptiles, insects, and small quadrupeds, in the twilight. The Common Bittern (*Botaurus stellaris*) is nearly as large as the heron, and is widely distributed over the eastern hemisphere. Formerly it was common in Britain, but the extensive drainage of late years has greatly diminished its numbers, and it is now a permanent resident only in the fen districts of England. The bittern in the days of falconry was strictly preserved, and afforded excellent sport. It sits crouching on the ground during the day, with its bill pointing in the air, a position from which it is not easily roused, and even when it takes wing, its flight is neither swift nor long sustained. When wounded it requires to be approached with caution, as it will then attack either man or dog with its long sharp bill and its acute claws. It builds a rude nest among the reeds and flags, out of the materials which surround it, and the female lays four or five eggs of a uniform dusky brown. During the breeding season it utters a booming noise, from which it probably derives its generic name, *Botaurus*, and which has made it in many places an object of superstitious dread. Its plumage for the most part is of a pale buff colour, rayed and speckled with black and reddish brown. The American Bittern (*Botaurus lentiginosus*) is somewhat smaller than the European species, and is found throughout the central and southern portions of North America, where it forms an article of food. It also occurs in Britain as an occasional straggler.

**BITTERS**, an aromatized alcoholic beverage, so named originally in the United States, where it was first used on account of its flavour and tonic influence. The drink by itself, or as an addition to unflavoured spirits, is used with considerable frequency in Europe, and especially in France it has come to be favourably regarded as a substitute for the insidious and deleterious absinthe. In the

year 1867 the daily consumption of bitters in Paris alone had reached 4000 litres. The preparation of bitters in Europe was at first a *specialité* of the Dutch, and Dutch bitters are the staple used in Great Britain. A considerable variety of recipes are in use for the preparation of Dutch bitters, but generally gentian root is the leading bitter ingredient in the beverages. The following is given as the composition of brandy bitters:—Gentian root, 4 oz.; orange peel, 5 oz.; cassia bark, 2 oz.; cardamoms, 1 oz.; and proof spirits, 1 gallon, coloured with  $\frac{1}{4}$  oz. of cochineal. Bitters prepared in the great French cities—Bordeaux, Rouen, Havre, Paris, &c.—contain extracts of gentian root, bitter orange peel, and orange flowers, with a proportion of sugar, and possess an alcoholic strength of about 40°.

**BITUMEN**. See *ASPHALT*, vol. ii. p. 715.

**BIZERTA**, or *BENZERT*, a seaport of North Africa, in Tunis, 38 miles from the capital, on a gulf or salt lake of the same name, which communicates with a shallow fresh water lake in the interior, formerly called Sisara, and now the lake of Gebel Ishkel. It occupies the site of the ancient Tyrian colony Hippo Zaritus, the harbour of which, by means of a spacious pier, protecting it from the north-east wind, was rendered one of the safest and finest on this coast. This important work, however, having been neglected by the Turks, the port has been to a great extent choked up. It is still visited by small vessels, and a certain amount of trade is carried on. The exports in 1869 were valued at £19,759. The town is about a mile in circuit; it is defended by several forts. The principal employment of the inhabitants is fishing. The adjoining lake abounds in fish, particularly mullets, the roes of which, dried and formed into the substance called botargo, form a considerable article of Mediterranean commerce. N. lat. 37° 17', E. long. 9° 50'. Population, 8000.

**BLACK**, DR *JOSEPH*, a celebrated chemist, was born, in 1728, at Bordeaux, where his father—a native of Belfast, but of Scottish descent—was engaged in the wine trade. He was educated from his twelfth to his eighteenth year at a grammar school in Belfast, whence he removed, in 1746, to the university of Glasgow. There he chose medicine as his profession, and devoted himself earnestly to physical science, being encouraged and guided by Dr Cullen, who then lectured on chemistry in Glasgow, and whose liberal and original views were in unison with Black's own aspirations. From assisting in Cullen's chemical experiments he acquired the delicate manipulative skill essential to success in original scientific research.

In 1751 he went to complete his medical studies at Edinburgh, and after taking his medical degree there in 1754 revealed himself as a great scientific discoverer. At that time the causticity of the alkalis was attributed to their absorbing an imaginary fire-essence known as phlogiston, an hypothesis which Black overthrew by showing that their causticity depended on their combining with a ponderable gas, carbonic acid, which he named *fixed air*, meaning that it was found not only as a separate fluid, but as *fixed* in solid bodies. This discovery, made by Black in his twenty-fourth year, was first sketched in a treatise, *De Acido e Cibus orto, et de Magnesia*, and afterwards embodied in his work, *Experiments on Magnesia, Quicklime, and other Alkaline Substances*, which Lord Brougham has declared to be "incontestably the most beautiful example of strict inductive investigation since the *Optics* of Sir Isaac Newton."

These works revolutionized chemistry. Previous investigators imagined that atmospheric air was the sole permanently aeriform element, a belief to which even Hales, who had shown that solids contain elastic fluids, had adhered. But when Black proved that a gas not identical with atmospheric air was found in alkalis, it was made plain

that various dissimilar gases might exist, and pneumatic chemistry was founded.

Although the full value of this discovery was not immediately visible, it added so greatly to Black's reputation that in 1756 he was chosen to succeed Dr Cullen as lecturer on chemistry in Glasgow University. He was also appointed to the chair of anatomy, but, not finding its duties congenial, exchanged it for the professorship of medicine. For some time he was so assiduous in preparing his lectures as to neglect fresh investigations, and even left the examination of carbonic acid, or *fixed air*, to be afterwards completed by Cavendish. He was highly esteemed as a professor by his students and colleagues, and became, through his attention and urbanity, a very popular physician in Glasgow. From 1759 to 1763 he prosecuted inquiries resulting in his theory of *latent heat*, which may be thus summarized—A solid liquefies or a fluid vaporizes through heat uniting with the solid or fluid body, and a fluid solidifies or a gas liquefies through the loss of heat; but in no case is this increase or diminution of heat detected by the senses or the thermometer. Black therefore named that heat *latent* which alters the condition, not the temperature, of a body. He likewise proved that bodies of equal masses require different increments of heat to raise them to the same sensible temperature—a doctrine now known as the law of *specific heat*.

His theory of latent heat he corroborated by numerous experiments, but he never published a detailed account of it, an omission which enabled others to lay claim to his great discovery. Thus M. Deluc, in 1788, declared himself its author. In 1766 Black was elected to succeed Cullen in the chair of chemistry at Edinburgh University. In this office he bestowed great care on his lectures, striving to give a lucid exposition of ascertained facts rather than to effect new discoveries; and such an interest did he communicate to his subject, that chemistry was for a time, it is said, regarded as a fashionable accomplishment in the Scottish capital.

He was intimate with the great men who adorned Edinburgh society during the second half of the eighteenth century, counting among his friends Watt, Hume, Robertson, Hutton, Adam Smith, and, at a later period, Robison, Playfair, and Dugald Stewart. His constitution had always been feeble, and he was ultimately reduced to the condition of a valetudinarian, which may account for the indifference he manifested during his latter years to original research. He retired from his professorship in 1796, and on the 26th November 1799 passed away so quietly that a cup of water, which he had held in his hand, remained unspilled after he had breathed his last. At the instance of Lavoisier he had been elected a member of the Paris Academy of Sciences.

Black was singularly modest, gentle, and sincere; his philosophic tranquillity was seldom ruffled; and his sagacious diffidence was equally conspicuous in his scientific inquiries and in his social relations. He has been called the founder of modern chemistry. When he began his career that branch of knowledge had only recently been raised to the rank of a true science through the efforts of Hermann Boerhaave, and was in many quarters even regarded with suspicion as being akin to alchemy on the one hand, and to humble trades on the other. But after Black's discoveries its scope and capabilities were immensely extended, and no one could then question its claim to rank with the most important sciences. The only works of his which appeared in print during his lifetime were *Experiments on Magnesia, &c.*, *Observations on the more ready Freezing of Water that has been boiled*, and *Analysis of the Waters of some Boiling Springs in Iceland*.

His lectures on chemistry were issued after his death. (*Cf.* Prof. Robison's *Life of Black*.)

**BLACK FOREST** (German, *SCHWARZWALD*), an extensive upland district on the right bank of the upper Rhine, stretching from that river to the Neckar and upper Danube. See *BADEN* and *WÜRTEMBERG*.

**BLACK SEA**, or *EUXINE*, the *Pontus Euxinus* of the ancients, is a large inland sea, bounded on the W. by the Turkish provinces of Rumilia, Bulgaria, and Moldavia; on the N. by South Russia, including Bessarabia, Kherson, and Taurida; on the E. by the Russian provinces of Circassia and Transcaucasia; and on the S. by the Turkish provinces of Asia Minor. It is entered from the Mediterranean through the channel of the Dardanelles or *Hellespontus*, the Sea of Marmora or *Propontis*, and the channel of Constantinople or *Thracian Bosphorus*; and it is connected with the Sea of Azoff, or *Palus Mæotis*, by the strait between the Crimea and the isle of Taman, anciently the *Cimmerian Bosphorus*, and known by the various modern names of the Strait of Kertch, of Yenikale, and of Taman.

The first navigators of Greece who ventured into this sea having been repulsed or massacred by some of the fierce tribes inhabiting its coasts, their countrymen gave it the name of *Pontus Axenos*, or "sea unfriendly to strangers." But when the repeated visits of the Greeks had rendered these tribes more familiar with strangers, and commercial intercourse had softened down the original ferocity of their character, Grecian colonies were established at different points on the shores of this sea, and the epithet *Axenos* was changed into *Euxinus*, which has the opposite import, and means "friendly to strangers." The modern name seems to have been given to it by the Turks, who, being accustomed to the navigation of the *Ægean*, the islands of which furnish numerous harbours of refuge, were appalled by the dangers of a far wider expanse of water without any shelter, subject to sudden and violent storms, and often covered with dense fogs.

The basin of the Black Sea is of an irregular ovate form, its long diameter lying nearly E. and W. Its greatest length, from the head of the Bay of Burghaz in Rumilia on the west to the boundary between Transcaucasia and Asiatic Turkey near Batum on the east, is about 720 miles. Its greatest breadth is in its western portion, between the estuary of the Dnieper on the north and the mouth of the Sakaria on the south, where it is 380 miles; its middle portion is narrowed, by the projection of the Crimean peninsula on the north and of the coast line of Anatolia between Cape Kerempe and Sinope on the south, to 160 miles; but further east it widens out again between the Strait of Kertch on the north and the mouth of the Kizil Irmak (the ancient *Halys*) on the south, to 260 miles. Its total area, including the Sea of Azoff, is about 172,500 square miles. The western coast line of the Black Sea, for some distance northwards from the Bosphorus, is high and rocky, having ranges of hills at its back; and the water rapidly deepens to from 30 to 40 fathoms. Between their northern extremity and the range of the Balkans (the ancient *Hæmus*), which extends east and west, terminating in Cape Emineh, there is a large bay, named after the town of Burghaz at the head of it, which affords a safe anchorage for large ships, the only one on this coast. Between Cape Emineh and Varna the coast line is again low and the shore shallow; and the same condition extends, with but little interruption, along the low-lying region called the Dobrudscha, which extends to the mouth of the Danube. This great river discharges itself by seven mouths, among swampy islands and shifting banks; and the quantity of *detritus* brought down by it is so large as not only to form a very extensive bar, but also to require the con-

tinal use of artificial means for its removal from the bed of the navigable channels. The same low coast-line continues along the southern boundary of the Russian steppes, to the shallow inlet which forms the estuary of the Dniester, and of which the mouth is nearly closed by a bar; beyond which, towards Odessa, the coast-line is more lofty, and the waters deepen more rapidly, so that it has been possible to construct a harbour in which ships of considerable tonnage can lie securely. Between Odessa and the mouth of the Dniester the shore again becomes low, and the water shallow; and the outlet of that river, which also receives the River Bog or Bug, is a long shallow bay bordered by shifting sand-banks, which is called the Gulf of Lemn or the Bay of Kherson. Only ships of light draught of water can navigate these rivers, of which the Bug is the deeper; and vessels of war, which are built and repaired at the arsenals of Kherson and Nicolaieff, are artificially floated up and down. The Crimean peninsula is separated from the mainland on the western side by the Gulf of Perekop, the northern boundary of which is formed by a narrow belt of sand that runs nearly straight for a distance of 80 miles, and was celebrated by ancient geographers as the *δρόμος Ἀχελέως*. The inner portion of this gulf is so shallow that only vessels of very light draught can make their way to Perekop, which is situated on the narrow isthmus that divides it from the Sea of Azoff. Along the western coast of the Crimea, however, the coast-line gradually rises, and the shore deepens more rapidly; and at Eupatoria there is a good harbour for ships of moderate size. South of Eupatoria, the coast is formed by cliffs, sometimes of considerable height; and the water is deep almost to their base. The harbour of Sebastopol somewhat resembles that of Valetta in being a deep inlet, subdividing into several branches, in any one of which the largest vessels may find good anchorage, and lie within a cable's length of the shore. Between Sebastopol and Cape Chersonese are six other bays running inland parallel to each other; and on rounding this we arrive at the harbour of Balacava, which is a remarkable inlet, having a very narrow entrance, and almost entirely surrounded by lofty heights. Eastward from Balacava there commences an almost continuous chain of lofty cliffs, with mountains behind them, whose height ranges from 4000 to 5800 feet; the commencement of this chain is formed by Cape Aia or Tarchanskoi, probably the *Parthenium* of Strabo, the most remarkable headland in the Crimea. Along the whole south-east coast of the Crimean peninsula the water is deep; but there is no good harbour between Balacava and the Bay of Kaffa, which furnishes an excellent and sheltered anchorage for large vessels, and was formerly much frequented when Kaffa or *Theodosia* (an ancient Greek colony) was a port of considerable importance. The peninsula of Kertch and the island of Taman, which separate the Sea of Azoff from the Black Sea, are for the most part low and sandy, the most elevated land in each being near the border of the Strait of Yenikale. On the western side of this strait the town of Kertch is situated, upon what was formerly known as the Hill of Mithridates.

The Sea of Azoff may be considered as the wide shallow estuary of the River Don, which discharges its waters into the north-eastern prolongation of the sea, sometimes distinguished as the Gulf of Taganrog; its area is estimated at about 14,000 square miles; and its depth, which is nowhere more than  $7\frac{1}{2}$  fathoms, diminishes near the shores to  $4\frac{1}{2}$  fathoms, and is less than 2 fathoms opposite the town of Taganrog. These depths show a tendency to yet further diminution through the deposit of river detritus,—vessels which could formerly pass up the gulf as far as Taganrog being no longer able to do so, whilst during certain winds the bottom becomes dry enough to be crossed between Taganrog and Azoff. The western portion of this basin is separated from the rest by a long narrow strip of low sandy land, enclosing what was named by the Greeks the Putrid Sea,—into which, when the wind is easterly, the water

of the Sea of Azoff passes through a narrow opening at the northern extremity of the bar, but which at other times consists of a series of swamps and quagmires, equally impassable to men and animals, and giving forth noxious exhalations that render the adjacent country nearly uninhabitable. The water of the Sea of Azoff is always less salt than that of the Black Sea; and when the Don is at its fullest, the large quantity of fresh water which is mingled with the water of the sea renders the latter nearly drinkable, and tends to empty the basin of its salt. When, on the other hand, the river brings down but little water, and the wind is from the south, there is a considerable reflux of the more saline water outside; and thus the average salinity of the water of the Sea of Azoff is maintained,—just as is seen to be the case on a larger scale with the Baltic. See BALTIC, p. 297.

The whole of the portion of South Russia that lies between the Dnieper and the Don is an almost unbroken steppe, but very little elevated above the sea-level; and there are abundant indications of its having been at no remote period covered by salt water. For not only are there numerous salt lakes and marshes at a long distance inland from the present coast-line, but extensive beds of sea-shells, which have become mineralized into strata of solid limestone, sometimes 30 or 40 feet in thickness. The like features prevail over the plain which lies between the Don and the Kuban, and which forms the eastern boundary of the Sea of Azoff; this plain, inhabited by nomadic Kalmucks and Cossacks, extends eastward to the desert of Astrakhan; and as salt marshes and beds of sea-shells are found there also, it is evident not only that both the Black Sea and the Caspian extended farther north than they do at present, but that they were then in continuity with each other over the plain of South Russia, though separated towards the south by the Caucasian Highlands. It is interesting to note that Pliny expressly stated that the Tauric Chersonese was not only surrounded by the sea, but that the sea covered all that northern portion of it which is now an alluvial level.

The island or peninsula of Taman, which forms the eastern border of the Strait of Yenikale, is for the most part an expanse of salt-marshes and lagoons, into which the River Kuban discharges itself,—one portion of its water passing into the Sea of Azoff and the rest into the Black Sea. At Anapa, a little to the east, the Caucasian range comes down to the sea; and thence around the shore of Circassia, the coast-line is high with a mountainous back-ground, and the water rapidly deepens. As the great mountain range trends inland, however, the coast becomes lower; and the region now termed Mingrelia, the ancient *Colchis*, is a fertile plain, through which run the River Rion (the ancient *Phasis*) having the important port of Poti at its mouth, and the Khopi, at the mouth of which is Redout Kale. Through these channels the merchants of Tiflis export the produce of the interior, and import European goods. Passing the boundary between Russia and Turkey, the coast-line begins to trend westwards, to the outlet of the large river Chouruk (the ancient *Batys*), where the fortified town of Batoum is situated at the base of the northern mountain range of Asia Minor. This range extends, with occasional interruptions, along the whole southern coast of the Black Sea, sending down spurs that form headlands and promontories, sometimes of considerable height. Owing to the steepness of the shores, there are few good anchorages here, except in the Bay of Samsoun, which receives the River Yeshil, and the Bay of Sinope, which receives the Kizil-Irmak,—at the mouths of which rivers there are plains formed by their alluvial deposit. From Cape Injeh westward to the Bosphorus, the coast-line of Anatolia is continuously elevated, with high mountains in the back-ground, occasionally projecting seawards as lofty promontories, of which Cape Kerempe is the most noteworthy; numerous rivulets come down from the mountains, and discharge themselves into

little coves; but excepting the Sakaria (the ancient *Sangarius*), there is no considerable river, and the water deepens very rapidly to 20 fathoms or more.

Although it is known that the depth of the central part of the basin of the Euxine reaches 1070 fathoms, the extent of this deep depression is not known. The increase of depth off the low-lying western and north-western shores is very gradual and regular, the lines of 20, 30, and 60 fathoms maintaining a general parallelism to the coast,—so that within this range the distance of a ship from land can be approximately ascertained by sounding. But outside the 60 fathom line the bottom deepens more rapidly and less regularly, depths of from 600 to 700 fathoms being met with in some parts within a few miles of it. The depth of the eastern portion of the basin has not been ascertained, but it is probably considerable.

The basin of the Euxine communicates with that of the Sea of Marmora by the Bosphorus, a strait about 20 miles long, from  $\frac{3}{4}$  to  $2\frac{1}{4}$  miles wide, and a depth of from 30 to 40 fathoms, resembling a broad river with high banks, which maintain a general parallelism, although the strait has seven distinct reaches. The region on either side presents distinct evidence of recent volcanic action.

The Sea of Marmora lies in the course of the channel that connects the Black Sea with the *Ægean*. Its bottom is depressed to a depth far greater than that of the channel of which it is an expansion. Its length from strait to strait is 110 geographical miles, and its greatest breadth is 43 miles. Round the shores, the depth generally ranges from 10 to 30 fathoms; but it rapidly increases in most parts; and depths of 100, 133, 266, and even 355 fathoms have been met with, chiefly near the line connecting the two straits.

The channel which connects the Sea of Marmora with the *Ægean* is properly termed the Hellespont,—the name Dardanelles, by which it is commonly known, being really that of the fortifications erected on the two sides of the strait by which its passage is guarded. The Sea of Marmora narrows to a breadth of ten miles towards the north-eastern entrance of the channel; at Gallipoli, the distance between the two shores suddenly contracts to about two miles; and between this and the *Ægean* end of the strait, that distance is further diminished at certain points to even less than a mile. The depth of the channel is considerable, being for the most part between 30 and 50 fathoms.

*Climate.*—The climate of the Black Sea is very peculiar,—the range of temperature between the summer and winter extremes being remarkably great. The summer isotherm of  $70^\circ$  runs a little way inland, nearly parallel to its north-western coast-line, whilst the summer isotherm of  $80^\circ$  passes along its southern coast-line, which is as warm as the southern coast-line of the Mediterranean, nearly  $10^\circ$  nearer the equator. Thus the whole area of the Black Sea lies, like that of the Mediterranean, between these two summer isotherms; and the evaporation from its surface during the warmer part of the year will consequently be enormous. During the winter months, on the other hand, the Black Sea is exposed to the chilling winds which come down to it from the Arctic regions, sweeping over the snow-covered plains of Russia, without any interruption from high mountain ranges; and nearly the whole of its area lies between the winter isotherms of  $30^\circ$  and  $40^\circ$ , the former passing round its northern coast, while the latter passes from the Bosphorus to Poti in Mingrelia. Thus it happens that, notwithstanding their high summer temperature, the northern shores of the Black Sea are more or less blockaded with ice during the winter,—this being most the case where the water is shallowest, and has its salinity lowered by the entrance of rivers. Thus the Sea of Azoff

and the Strait of Yenekale are always frozen over, as are also the northern ports between the Crimea and Odessa; while, on the other hand, the harbours of Kaffa and Sebastopol are never closed, and that of Odessa but seldom. It is recorded, however, that in 401 A.D. the surface of the Euxine was almost entirely frozen over, and that when the ice broke up enormous masses were seen floating in the Sea of Marmora for thirty days. In 762 A.D., again, the sea is said to have been frozen from the terminal cliffs of the Caucasus to the mouths of the Dniester, Dnieper, and Danube; and contemporary writers assert that the quantity of snow which fell on the ice rose to the height of from 30 to 40 feet, completely hiding the contour of the shores, and that on the breaking up of the ice in the month of February, the masses of it carried by the current into the Sea of Marmora reunited in one immense sheet across the Hellespont between Sestos and Abydos. No similar occurrence has been subsequently recorded.

The winds of the Black Sea are variable, except during summer, when they generally blow from the north-east, while at other seasons southerly or south-westerly winds often prevail. The area is very subject to fogs, which appear to proceed from the precipitation by a cold northerly current of the moisture which has been raised by evaporation from its surface, or has been brought thither by S. or S.W. winds. This sea is remarkable for the rapidity with which violent storms not unfrequently arise, often to subside again with like rapidity.

*Drainage Area.*—The drainage area of the Black Sea is one of the largest in the world, being estimated at 939,000 square miles, of which 825,000 lie in Europe and 114,000 in Asia. The largest of its rivers is the Danube, which has a total length of 1560 miles, and drains the immense area of 306,000 square miles in the southern portion of Central Europe; its western tributaries lie so near the southern tributaries of the Rhine and the Elbe, that a canal-communication has been established between them, by which small vessels can pass between the North Sea and the Black Sea. The Dnieper has a total length of 1050 miles, and drains an area of 195,500 square miles, chiefly in Western Russia and Russian Poland; its northern tributaries approach the southern tributaries of the Niemen; and a canal-communication has thus been established between the Black Sea and the Baltic. The Don, with a length of 1000 miles, drains an area of 176,500 square miles in South-Eastern Russia, which is conterminous with the basin of the Volga, being separated from it by the Sarpa Hills. Between the Dnieper and Danube, the two smaller rivers, the Bug and the Dniester, traverse respectively 440 and 660 miles in their course, and drain an area of more than 50,000 square miles (ten times greater than that of the Thames). Passing eastwards, we come to the Kuban, which drains the northern slopes of the Caucasus and the plains inhabited by the Black Sea Cossacks, and debouches near the entrance to the Sea of Azoff. But there is no other important river on the eastern coast, most of the water flowing from the mountainous region that separates the Black Sea from the Caspian passing into the latter. The northern slopes of the Armenian mountains furnish tributaries of the River Chouruk, a stream of moderate size, which enters the Black Sea to the east of Trebizond. On the southern coast the principal river is the Kizil Irmak (the *Halys* of the ancients), which drains the large central area of the northern portion of Asia Minor, while towards the western side the River Sakaria drains a large area in the province of Anatolia. Along the whole western coast of the Black Sea, from the Bosphorus to the Danube, no large stream empties itself into the basin,—most of the drainage of Rumilia being carried off by the River Maritza into the *Ægean*, whilst that of Bulgaria contributes to swell the Danube.

The greater part of the drainage area of the Black Sea, like that of the Baltic, is covered with snow during the winter months, and comparatively little water is then brought down by the rivers. With the return of spring, however, the melting of the snow increases the volume of fresh water poured into the sea, its rivers being at their highest in early summer. By far the larger part of this water is discharged at its north-western border; and the elevation of level thus produced establishes a current that sets along its western shore towards the outlet of the Bosphorus. But as the narrowness of this channel does

not allow it to give immediate passage to the overflow, a portion of the current continues to pass onwards along the southern shore, and, when more than usually strong, even completes the entire circuit of the sea. There are no perceptible tides in this basin.

As might be expected from the foregoing, the salinity of Black Sea water varies (like that of the Baltic) at different periods of the year; but in consequence of the much greater total mass of water contained in the deeper part of this basin, the variation of its salinity is by no means so great as that of Baltic waters,—the usual range of its sp. gr. being from about 1.012 to 1.014, which corresponds to a little less or a little more than half the salinity of ordinary sea-water.

The most contradictory notions have prevailed as to the influence of the Euxine waters on those of the Mediterranean,—some writers having represented the rivers of the former as important contributors to the maintenance of the level of the Mediterranean, which the enormous evaporation from that area is always tending to reduce; whilst others assert that the Bosphorus and Dardanelles' currents are entirely due to the agency of wind. A valuable datum is afforded by the condition of the Caspian, in the closed basin of which, contracted by a reduction of its level to 80 feet below that of the Black Sea, an equality is now established between the amount of water lost by evaporation and that which is restored by its rivers and by the rainfall on its own surface. The areas of the Caspian and of the Euxine are not very different; and though the axis of the former basin lies north and south, while that of the latter lies east and west,—so that the northern portion of the Caspian is colder, and the southern portion warmer, than the northern and southern portions of the Black Sea,—the annual average temperatures, and consequently the total evaporation, of the two areas cannot differ much. Now, the drainage area of the Volga is equal to that of the Danube, the Dnieper, and the Dniester taken together; the Ural, with the two Transcaucasian rivers, Kur and Araxes, may be considered as equalling the Don; and thus the Bug and the rivers of the Caucasus and Asia Minor may be regarded as furnishing the excess of water discharged into the Black Sea above that which is received by the Caspian. Hence, as the whole of the river and rain water annually discharged into the basin of the Caspian is only sufficient to replace that which is lost by evaporation during the same period, it follows that we may in like manner regard the principal rivers of the Black Sea as only fulfilling the same function; consequently, if the Bosphorus were closed, the water which they pour into the Euxine basin would not produce any elevation of its level, being entirely dissipated by evaporation. Thus the water which the Black Sea has to spare for the Mediterranean only represents the excess of its river supply above the total river supply of the Caspian; and that this excess is small in amount appears from the fact that the salinity of the water of the *Ægean* is not sensibly reduced by it below that of the Mediterranean. But that there is some excess is evident from the consideration that if the evaporation of the Black Sea were merely neutralized by the return of fresh water, its water would have the salinity of that of the great basin with which it is in free communication, instead of containing only about half its proportion. It is further evident, on the other hand, that a continual efflux of the half-salt water of the Black Sea, to be replaced only by the fresh water discharged into its basin by rain and rivers, would in time completely drain that basin of its salt; and as its proportion, though liable to seasonal variation, undergoes no sensible diminution from year to year, it is obvious that the salt which passes out must be replaced by a re-entry of *Ægean* water. The mode in which this re-

placement is effected has been recently elucidated by a careful examination of the currents of the Black Sea straits, of which an account will be presently given.

It is during the winter months, when a large proportion of the drainage area of the Black Sea rivers is covered with snow, that the supply of water is at its minimum; but it is then that the evaporation from its surface is also at its minimum; so that there is no reason to suppose that the level of the Black Sea ever falls below that of the *Ægean*. There can be no reasonable doubt that during the spring and early summer, when the melting of the snows causes the rivers to swell to their highest, the quantity of fresh water thus brought into the basin, being greater than that which is lost by evaporation (as is shown by the general reduction which then takes place in the salinity of its contents), would cause a considerable rise of level, if this were not kept down by the outflow through the straits.

*Dardanelles and Bosphorus Currents.*—It has been known from very early times that a current, usually of considerable strength, sets outwards through the Black Sea straits during a large part of the year,—its rate being subject, however, to considerable variation in accordance with the breadth of the channel, and also with the force and direction of the wind. Thus, when the N.E. wind is of average strength, the rate of the current at Gallipoli is about 1 knot per hour; whilst in the "Narrows" at Chanak Kaleski it is about 3 knots, increasing with a strong wind to about 4½ knots. In calm weather the out-current of the Dardanelles is usually slack; and if, as sometimes happens even during the general prevalence of N.E. winds, the wind should suddenly blow strongly from the S.W., the surface outflow may be entirely checked. It requires a continuance of strong S.W. wind, however, to reverse its direction; and its rate, when thus reversed, never equals that of the out-current. The Bosphorus current has not been as carefully studied as that of the Dardanelles; but its rate is greater, in accordance with the limitation of its channel, which is scarcely wider at any point than the "Narrows" of the Dardanelles. It continues to run, though at a reduced rate, when there is no wind, and is not known to be ever reversed except in winter after a S.W. gale of long duration. Even then it appears that the reversal is confined to the superficial stratum,—the direction of the sub-surface water-weeds proving that there is still an outflow from the Black Sea into the *Ægean*. Hence it cannot be reasonably maintained that it is by this occasional and superficial reversal that the immense mass of salt continually being carried outwards by the Bosphorus and Dardanelles currents is restored to the Black Sea basin.

The existence of an inward under-current (although controverted by an authority of weight) has been clearly demonstrated by the recent experimental researches of Captain Wharton, R.N., of H.M. surveying ship "Shearwater." By the use of a "current-drag," so constructed and suspended as always to present a large vertical surface, it was found that when the outward surface-current was at its strongest there was an inward under-current sufficiently strong and rapid to carry inwards the suspending buoy.

The difference in specific gravity of water obtained from different depths was found, in Captain Wharton's investigations (as in those previously made by Dr Carpenter, in conjunction with Captains Calver and Nares, in the Strait of Gibraltar), to afford, under ordinary circumstances, a very sure indication of the direction of the movement of each stratum,—the heavy water of the *Ægean*, as a rule, flowing inwards, and the lighter water of the Black Sea flowing outwards. And it was indicated alike by both modes of inquiry that the two strata move in opposite directions, one over the other, with very little intermixture

or retardation,—the transition between them being usually very abrupt. The anomalies occasionally met with seemed due to the prevalence of opposite winds at the two ends of the straits.

Putting aside for the time the influence of wind, the double current of the Black Sea straits may be accounted for as follows:—The excess of fresh water discharged into the basin of the Black Sea is always tending to raise its level; and this produces an outward surface-current, which as regularly tends to keep it down. On the other hand, the reduced salinity of the Euxine column gives to the *Ægean* column an excess of lateral pressure, which causes its lower stratum to flow back into the Black Sea basin; and as the equality in the amount of salt thus carried back by the under-current to that which escapes by the surface-current is indicated by the maintenance of the standard salinity of Black Sea water, it follows that, as the water which escapes contains about half as much salt in equal measures as the water that enters, the volume of the latter must be about half that of the former.

Now, when the rate of the surface-current is augmented by a N.E. wind, there will be not only a more rapid lowering of the Black Sea level, but a tendency to elevation at the *Ægean* end of the strait; and as this will augment the difference between the downward, and therefore the lateral, pressures of the two columns, the force and volume of the inward under-current will be augmented. When, on the other hand, the S.W. direction of the wind reverses the surface-current, it tends, by piling up the water at the N.E. end of the strait, to augment the weight of the Black Sea column,—the excess of which (notwithstanding its lower salinity) over that of the *Ægean* column, will then produce a reversal of the under-current also. When the S.W. wind is moderate enough to check the surface outflow without reversing it, the inward under-current will likewise be brought to a stand; for a slight rise in the level of the Black Sea column will cause its greater height to compensate for the greater salinity of the *Ægean* column, so that their lateral pressures will be equalized.—We have here a "pregnant instance" of the potency of slight differences in level and in salinity to produce even rapid movements of considerable bodies of water; and a strong confirmation is thus afforded by direct observation to the doctrine that differences in density produced by temperature are adequate to give rise to still larger, though slower, movements of the same kind in the great ocean basins.

*Zoology.*—The basin of the Black Sea is frequented by seals, dolphins, and porpoises; and it is said that in the neighbourhood of the mouths of the Danube the porpoise is perfectly white, so that the Greek mariners, when they catch sight of it, know that they are in the current of that river, although in 30 fathoms water, and many leagues from land. The fish of the Black Sea appear to be for the most part the same as those of the Caspian and the Sea of Aral. Its northern rivers bring into it the sturgeon, sterlet, and other fresh-water fish, which can live in and near their estuaries. On the other hand, its waters are elsewhere salt enough for the mackerel, whiting, mullet, turbot, and sole. The *pelamys* spoken of by Strabo as issuing from the *Maotis* (Sea of Azoff) in shoals, and as following the coast of Asia, is still abundant; though commonly spoken of as the herring, it seems to be a large sprat. The principal fish that enters this basin from the Mediterranean is the tunny, which comes into the Black Sea in large numbers at the spawning season. The other inhabitants of the Black Sea have not been especially studied; but it may be noted that a species of *Teredo* is very common and destructive both to ships and to wooden harbour-works, and that it is not confined to the salter waters of the basin, but frequents the estuaries where the water is almost fresh. (W. B. C.)

**BLACKBIRD** (*Turdus merula*), belongs to the *Turdæ* or Thrushes, a family of Dentirostral Birds. The plumage of the male is of a uniform black colour, that of the female various shades of brown, while the bill of the male, especially during the breeding season, is of a bright gamboge yellow. The blackbird is of a shy and restless disposition, courting concealment, and rarely seen in flocks, or otherwise than singly or in pairs, and taking flight when startled with a sharp shrill cry. It builds its nest in March, or early in April, in thick bushes or in ivy-clad trees, and usually rears two broods each season. The nest is a neat structure of coarse grass and moss, mixed with earth, and plastered internally with mud, and here the female lays from four to six eggs of a blue colour speckled with black. The blackbird feeds chiefly on fruits, worms, the larvæ of insects, and snails, extracting the latter from their shells by dexterously chipping them on stones; and though it is generally regarded as an enemy of the garden, it is probable that the amount of damage done by it to the fruit is amply compensated for by its undoubted services as a vermin-killer. The notes of the blackbird are rich and full, but monotonous as compared with those of the song-thrush. Like many other singing birds it is, in the wild state, a mocking-bird, having been heard to imitate the song of the nightingale, the crowing of a cock, and even the cackling of a hen. In confinement it can be taught to whistle a variety of tunes, and even to imitate the human voice. It is found throughout Europe, Palestine, and the northern parts of Africa; and Darwin states that he observed it as far west as the Azores. Individuals reared in Britain, it is said, do not migrate; but annually great flocks arrive on the eastern shores of England from more northern countries, remaining for a few days only, and then proceeding southward.

**BLACKBURN**, a large manufacturing town and municipal borough of England, situated on a stream called, in *Domesday Book*, the Blackeburn, but now only known as "The Brook," in the north-eastern division of the county of Lancashire, 209 miles from London by railway, 15 E. of Preston, and 30 N.N.W. of Manchester. Besides its numerous churches and chapels, the public buildings of Blackburn comprise a large town-hall, finished in 1856, a market-house, an exchange, built in 1865, a county court (1863), public baths (1864), and, outside the town, an infirmary (1862). A public park of about 50 acres was opened in 1857. Since about 1865 a variety of extensive and important improvements have been effected in the general condition of the town, which is now well paved and lighted, has an elaborate system of drainage, and receives an abundant supply of water. Previous to that date the so-called streets were, over a large area, almost useless for purposes of traffic. The staple trade of Blackburn has long been the manufacture of cotton, for the development of which a great deal was done by some natives of the town, such as Peel and Hargreaves, in the last century. The subordinate branches include woollen factories, engineering works, iron foundries, and breweries. In 1871 there were employed in the cotton factories 14,220 men and 17,075 women, of twenty years of age and upwards; the engineering works gave employment to 356 men, and the iron manufacture to 794. Coal, and lime, and building stone are abundant in the neighbouring district, which is, however, very far from fertile. The Leeds and Liverpool Canal passes the town, which has also extensive railway communication. Blackburn is a place of some antiquity, and its parish church of St Mary's (for the most part taken down in 1813), dated from before the Norman Conquest. It was for a time the chief town of a district known as Blackburnshire, and as early as the reign of Elizabeth ranked as a flourishing market town. About