

the bottoms of the cups, and thus causes the ball to drop on the head of the type, beneath which it presses against the recording sheet on the cylinder. The ball immediately rolls down a groove to the sheriff's desk outside the chamber, where it is handed to the next voter, *only one ball being used* in connection with each register (unless, of course, there are more votes than one to be given). The closing of the exit door restores the bottoms to the cups. This simple and effectual plan has the merit of secrecy, of immediate detection of fraud (*e.g.*, the introduction of a non-official ball to the cup), of rapidity in voting and in counting, and of leaving almost nothing to the voter's presence of mind. The voter can make only one well-defined mark on the paper, and this he can do only in leaving the chamber before the next voter has entered. Mr Davie's invention, which in 1870 received a prize from the Royal Scottish Society of Arts, is obviously not adapted to cumulative voting, but may be worked with any number of candidates under single voting. Although the motion of the cylinder would record in a diagonal direction the series of votes, it would be practically impossible to identify votes from a numbered list of the voters. (w. c. s.)

BALLYCASTLE, a seaport town of Ireland, county Antrim, situated on a bay opposite Rathlin island. The town is well built, consisting of two parts, about a quarter of a mile asunder, and connected by a fine avenue. Towards the close of the 18th century, one of the Boyd family devoted himself to the extension and improvement of the town, establishing manufactures, endowing charities, and building churches, and succeeded in producing a temporary vitality. Upwards of £150,000 is said to have been expended upon the pier and harbour; but the violence of the sea overthrew the former, and the latter has been filled with sand. To the east of the town are the remains of an abbey. Population in 1871, 1253.

BALLYMENA, a town of Ireland, county Antrim, on the Braid, an affluent of the Maine, two miles above their junction. It is 33 miles N.N.W. of Belfast, with which it is connected by railway. The town owes its prosperity chiefly to its linen trade, introduced in 1733, which gives employment to the greater part of the inhabitants. It has a parish church, several chapels and schools, a market-house, and four branch banks. There is a newspaper published in the town called the *Ballymena Observer*. Population in 1871, including Hanyville in the suburbs, 7931.

BALLYSHANNON, a seaport and market-town of Ireland, county of Donegal, situated at the mouth of the Erne. Lat. 54° 30' N., long. 8° 11' W. The river is here crossed by a bridge of fourteen arches, which connects the town with the suburb of Purt. Below the bridge the river forms a beautiful cascade, 150 yards wide, with a fall at low water of 16 feet. The harbour is a small creek of Donegal Bay, about 600 yards long and 350 yards broad, and is only accessible to small vessels. The town contains a church, several chapels, a bank, a market-house, barracks, and a union workhouse. The salmon fishery is the only important occupation. Previous to the Union Ballyshannon returned two members to the Irish Parliament. Population in 1871, 2958.

BALMEZ, JAIME LUCIEN, a Spanish ecclesiastic, eminent as a political writer and a philosopher, was born at Vich in Catalonia, on the 28th August 1810, and died there on the 9th July 1848. The most important of his works, and that on which his fame principally rests, is entitled *El Protestantismo comparado con el Catolicismo en sus relaciones con la Civilizacion Europea*, published 1842-44, a most able defence of Catholicism. It has been translated into French, Italian, German, and English. The best of his philosophical works, which are able expositions of

the old scholastic system of thought, are the *Filosofia Fundamental*, 1846, and the *Corso de Filosofia Elemental*, 4 vols. 1847. The *Protestantism and Catholicity* and the *Fundamental Philosophy* have both been translated into English (1849, 2 vols. 1857). Nearly all the works are to be had in German and French. See M. de Blanche-Raffin, *Jacques Balmez, sa Vie et ses Ouvrages*, Paris, 1849.

BALMORAL CASTLE, a residence of Her Majesty Queen Victoria, on the right bank of the River Dee, about 9 miles above Ballater and 50 miles from Aberdeen. The property, which now consists of upwards of 10,000 acres, besides a large tract of hill ground, belonged in its original extent to the Farquharsons of Inverey, by whom it was sold to the Earl of Fife. In 1848 it was leased by the late Prince Consort, and in 1852 was finally purchased for a sum of £32,000. The castle, which was erected at Prince Albert's private expense, is of the Scotch baronial style of architecture.

BALNAVES, HENRY, a Scottish Protestant, born at Kirkcaldy in Fife, in the reign of James V., and educated at the university of St Andrews. There is some doubt both as to the exact date of his birth, which has been fixed as 1520, and as to the rank in society to which he belonged. He completed his studies on the Continent, and, returning to Scotland, entered the family of the Earl of Arran, who at that time was regent; but in the year 1542 the earl dismissed him for embracing the Protestant religion. In 1546 he was implicated in the murder of Cardinal Beaton, at least he is known to have taken refuge with the conspirators in the castle of St Andrews; and when they were at last obliged to surrender to the French, he was sent with the rest of the garrison as a prisoner to France. During his confinement at Rouen he wrote the work entitled *Confession of Faith*, to which Knox added marginal notes and a preface; but it was not published till 1584, five years after his death. He returned to Scotland about the year 1559, and having joined the Congregation, was appointed one of the commissioners to treat with the duke of Norfolk on the part of Queen Elizabeth. In 1563 he was made one of the lords of Session, an office which he is said to have held for the first time in 1538, and was appointed by the General Assembly, with other learned men, to revise the *Book of Discipline*. Knox, his contemporary and fellow-labourer, gives him the character of a very learned and pious man. Balnaves died at Edinburgh in 1579.

BALSAM, an oleo-resin or natural compound of resin and essential oil, in such proportions that the substance is in a viscous or semi-fluid condition. The gradations from a solid resin to a limpid essential oil are insensible, and most resins have a balsamic consistency on their exudation, only hardening by exposure to air. It has been proposed to limit the name balsam to such substances as contain cinnamic or an analogous acid in addition to the volatile oil and resin which turpentine contains alone; but this distinction has not been carried out.

The fragrant balsams which contain cinnamic or benzoic acid may, however, be regarded as a distinct class, allied to each other by their composition, properties, and uses. Those of this class found in commerce are the balsam of Peru, balsam of Tolu, liquid storax, and liquidambar. *Balsam of Peru* is the produce of a lofty leguminous tree, *Myrospermum peruvianum*, growing within a limited area in San Salvador, Central America, but now introduced into Ceylon. It is a thick, viscid oleo-resin of a deep brown or black colour and a fragrant balsamic odour. It has been analysed by Kachler, who thus states its percentage composition,—cinnamic acid 46, resin 32, benzylic alcohol 20. It is used in perfumery, and in medicine as a stimulant application to indolent sores, as well as internally for

asthma and pectoral complaints. *Balsam of Tolu* is likewise produced from a species of *Myrospermum*, *M. toluiferum*. It is of a brown colour, thicker than Peru balsam, and attains a considerable degree of solidity on keeping. It also is a product of equatorial America, but is found over a much wider area than is the balsam of Peru. Tolu balsam consists of a combination of inodorous resin with cinnamic acid, no benzoic acid being present in it. It is used in perfumery and as a constituent in cough syrups and lozenges. *Liquid storax* is a balsam yielded by *Liquidambar orientalis*, a native of Asia Minor. It is a soft resinous substance, with a pleasing balsamic odour, especially after it has been kept for some time. It contains a principle—styril or cinnamene—to which it owes its peculiar odour, besides cinnamic acid, stryacin, and a resin. Liquid storax is used in medicine as an external application in skin diseases, and internally as an expectorant. An analogous substance is derived from *Liquidambar Alvingia* in Java. *Liquidambar balsam* is derived from *Liquidambar styraciflua*, a tree found in the United States and Mexico. It contains cinnamic acid, but is destitute of benzoic acid.

Of balsams entirely destitute of cinnamic and benzoic constituents the following are found in commerce:—*Mecca Balsam* or *Balm of Gilead*, yielded by the *Balsamodendron Berryi* (*B. gileadense* of De Candolle), a tree growing in Arabia and Abyssinia, is supposed to be the balm of Scripture and the *βάλσαμον* of Theophrastus. When fresh it is a viscid fluid, with a penetrating odour, but it solidifies with age. It was regarded with the utmost esteem among the nations of antiquity, and to the present day it is peculiarly prized among the people of the East. *Balsam of Copaiba* or *Capivi* is a fluid oleo-resin of a pale brown or straw colour, produced from several trees of the genus *Copaifera*, growing in tropical America. It possesses a peculiar odour and a nauseous persistent tarry taste. Balsam of copaiba contains from 40 to 60 per cent. of essential oil, holding in solution a resin from which capivic acid can be prepared. It is chiefly used in medicine for the treatment of inflammatory affections of mucous surfaces. Under the name of *Wood Oil*, or *Gurjun Balsam*, an oleo-resin is procured in India and the Eastern Archipelago from several species of *Dipterocarpus*, chiefly *D. turbinatus*, which has the odour and properties of copaiba, and is used for it in East Indian hospital practice. Wood oil is also used as a varnish in India, and forms an effective protection against the attacks of white ants. A substitute for copaiba is also found in the dark red balsam yielded by *Hardwickia pinnata*, a leguminous tree.

Canada Balsam.—The oleo-resins obtained from coniferous trees are usually termed turpentine, but that yielded by *Abies balsamea* is known in commerce as Balsam of Canada. It is a very transparent substance, somewhat fluid when first run, but thickening considerably with age, possessed of a delicate yellow colour, and a mild terebinthous odour. According to Flückiger and Hanbury it contains 24 per cent. of essential oil, 60 per cent. of resin soluble in alcohol, and 16 per cent. of resin soluble only in ether. It has been used for the same purposes as copaiba, but its chief uses are for mounting preparations for the microscope and as a varnish.

BALTA, the chief town of a circle of the same name in the Russian government of Podolia. It stands on the Kodima, near its junction with the Bug, and carries on a large trade in cattle and horses and the raw products of the surrounding district. It has two great annual fairs, the more important being held at Whitsuntide and the other in June. A variety of industries, such as tallow-melting, soap-boiling, tile-making, and brewing are likewise prosecuted. The Jews form a very considerable part of the

population, which in 1867 numbered 14,528. Balta was in great part destroyed by the Russians in 1780.

BALTARD, LOUIS PIERRE, a distinguished French architect and engraver, was born at Paris in 1765, and died in 1846. He was originally a landscape painter, but in his travels through Italy was so much struck with the beauty of the Italian buildings, that he changed his profession and devoted himself to architecture. In his new occupation he achieved great success, and was selected to prepare the plans for some of the largest public edifices in Paris. His reputation, however, rests not so much on his practical performances in architecture as on his great skill in the art of engraving. Among the best known of his plates are the drawings of Paris (*Paris et ses Monuments*, 2 vols. fol., 1803), the engravings for Denon's *Égypte*, the illustrations of Napoleon's wars (*La Colonne de la grande Armée*), and those contained in the series entitled the *Grand Prix de l'Architecture*, which for some time he carried on alone. He has also gained distinction as an engraver of portraits.

BALTIC SEA. The name by which this inland sea is commonly designated is first found in the 11th century, in the work of Adam of Bremen, entitled *Chorographia Scandi-*



Sketch Map of Baltic Sea.

navia. The derivation of the word is uncertain. It seems probable that, whatever may be the etymology of the name *Baltic*, that of the Great and Little Belts is the same. The Swedes, Danes, and Germans call it the *Ostsee* or East Sea. The Baltic is enclosed by Sweden, Russia, the German empire, and Denmark; and it communicates with the North Sea, by the winding channel which lies between the southern part of the Scandinavian peninsula and the northern peninsula of Schleswig and Jutland. The first part of this channel is in great measure blocked by the islands of Zealand and Fünen, so as to form the three narrow passages which are known as the Sound (between

Sweden and Zealand), the Great Belt (between Zealand and Fünen), and the Little Belt (between Fünen and Jutland). Each of these forms a distinct communication between the Baltic and the Cattegat, which is the open portion of the channel lying between the coast of Sweden and the eastern side of Jutland; while the Cattegat opens freely into the Skager Rack, which is the continuation of same open channel, between the southern end of Norway and the north-west coast of Jutland, into the North Sea.

The length of the Baltic Sea, from Swinemünde in the S. to Tornea in the N., is nearly 900 miles; and its greatest width, between Karlsrona and Memel, exceeds 200 miles. Its whole area, including the Gulfs of Bothnia and Finland, is about 160,000 geographical square miles. It runs first in an easterly direction as far as Memel, a distance of 300 miles, and then northwards as far as lat. 59° 21' N., a distance of 350 miles, at which point it separates into two great gulfs. One of these, the Gulf of Finland, runs nearly due E.; the other, the Gulf of Bothnia, almost N. The Gulf of Bothnia is 400 miles in length, with an extreme breadth of 120 miles, but where narrowest it does not exceed 40 miles. The archipelago of Åland lies at its entrance. The Gulf of Finland is 280 miles in length, with a mean breadth of 60 or 70 miles.

The depth of the Baltic rarely exceeds 100 fathoms—being greatest between the island of Bornholm and the coast of Sweden, where it reaches 115 fathoms, and least in the neighbourhood of the mouths of large rivers, which bring down a great quantity of earthy matter, especially in the spring, so that in many parts the bottom is being so rapidly raised by its deposit that the mouths of rivers formerly navigable are now inaccessible. This is especially the case in the northern part of the Gulf of Bothnia, above Quarken, where several tracts are now dry land which were once water; and also in the neighbourhood of Tornea, where meadows now take the place of waters which were traversed in boats by the French Academicians, when they were measuring an arc of the meridian. Along the southern coast the shallowness of the harbours is a great obstacle to navigation, especially since they are closed by ice for nearly one-third of the year. On the western side it is not more than 15 fathoms deep; and, in general, it is only from 8 to 10 fathoms. On the S. it nowhere exceeds 50 fathoms. The Gulf of Finland suddenly shallows from 50 or 60 fathoms to 5, or even less. The average depth of the Gulf of Bothnia is not greater than that of the rest of the sea. Numerous rocky islands and reefs, many of them level with the water, render the navigation of this sea extremely dangerous.

The shore of the Baltic is generally low. Along the southern coast it is for the most part sandy,—with sand-banks outside, and sand-hills and plains inland. Where streams come down, there are often fresh-water lakes termed *haffs*, which are separated from the sea by narrow spits called *nehrungs*. Two of these *haffs* are of great extent; one of them, termed the Frische Haff, lies between Danzig and Königsberg, which last town is situated on the part of it most remote from the sea; the other, termed the Kurische Haff, lies between Königsberg and Memel, the latter town being situated on the channel connecting the haff with the sea. Near the entrance to the Gulf of Finland the coast becomes rocky, and continues to be so for the most part around the gulfs both of Finland and Bothnia, except towards the head of each; the rocks, however, are never high. The shores of the southern part of the Swedish peninsula are mostly high, but not rocky; at Stockholm, however, there is an archipelago of rocky islands, on some of which the town is partly built.

Drainage Area.—The Baltic may be considered as the estuary of a great number of rivers, none of them individu-

ally of great size, but collectively draining a very large area, which is estimated at about 717,000 square miles, or nearly one-fifth of the entire area of Europe. This great drainage area is remarkable for the small proportion of its boundary that is formed by mountains or high table-lands,—its greater part consisting of land of no considerable elevation, which slopes down very gradually to its coast-line, and of which a large proportion is covered by lakes. This is especially the character of the drainage area of the Neva, whose waters are immediately derived from the large shallow Lake Ladoga, which receives the contributions of numerous other lakes, Onega being the largest, though Lake Saima in Finland, with its irregular prolongations, is scarcely less extensive. The entire surface drained by the Neva is estimated at about 100,000 square miles, or nearly twenty times that of the drainage area of the Thames. Through Lake Onega, the Neva is connected with the Dwina and the Volga by canals, through which small vessels can pass from the Baltic into either the White Sea or the Caspian. The Duna or South Dwina, which discharges itself into the Gulf of Riga, is another important river, draining an area of about 35,000 miles in West Russia, and having a length of 520 miles, of which 405 miles are navigable. The drainage area of the Niemen, which enters the Baltic at Memel, is conterminous with that of the Duna, and is of about the same extent; this river is navigable for more than 400 miles from its outlet, and communicates with the Dnieper by a canal through which vessels can pass from the Baltic to the Black Sea. The Vistula, which receives the waters of the whole area of Russian and Prussian Poland, flowing past Warsaw into the Baltic at Dantzic, is a very large and important river, having a length of 520 miles, of which 430 are navigable, and a drainage area of 72,000 square miles. And the Oder, rising in the hill districts of Silesia, drains the extensive level areas of Brandenburg and Pomerania, and discharges into an estuary, that may be said to begin from Stettin, the water drawn from an area of 45,000 square miles. Numerous rivers discharge themselves into the Gulf of Bothnia, bringing down water from the mountain ranges of Sweden and Norway; but their course is comparatively short and direct, with few tributaries, so that, individually, they do not attain any great size. The drainage of the more level southern portion of Sweden is for the most part collected by the great lakes Wener, Wetter, and Mälär, of which the first pours its water into the North Sea, and the others into the Baltic. By means of a canal joining Lakes Wener and Wetter vessels can pass directly from the Cattegat into the Baltic.

Climate.—It is not only, however, the extent of its drainage area, but the large proportion borne by the rain and snow which fall upon that area to the amount dissipated by evaporation from its surface, that goes to swell the aggregate of fresh water poured into the basin of the Baltic; for there is probably no inhabited region of the whole globe over which so large a quantity of snow falls, in proportion to its area, as it does in the countries round this basin. They receive, direct from the Atlantic, a vast amount of moisture brought by its west and south-west winds; and even the winds which have already passed over the low plains of Jutland and Northern Germany will have parted with little of their moisture before reaching the Baltic provinces of Russia. When these vapour-laden west and south-west winds meet the cold dry east and north-east winds of Siberia, their moisture is precipitated, in summer as rain, and in winter as snow; and owing to the prevalence of a low atmospheric temperature through a large part of the year, the proportion lost by evaporation is extremely small as compared with what passes off from other inland seas. The large excess of the amount of fresh water dis-

charged into the basin, over that which passes off by evaporation from its surface, is indicated by its low salinity, which, however, varies considerably in its different parts and at different seasons of the year. The temperature of the Baltic is remarkable for its *range*, which is rather that of a terrestrial than of a marine area—this being doubtless owing in great degree to the fact that its shallowness and the low salinity of its water allow a large part of its surface to be frozen during the winter. Nearly the whole of the Gulf of Bothnia, with the land enclosing it on both sides, lies between the January isotherms of 10° and 20°—the former crossing it near its head, and the latter near its junction with the Baltic proper; and the whole of the Baltic proper, with the land enclosing it on the east, south, and west, lies between the January isotherms of 20° and 30°. On the other hand, the July isotherm of 60°, which crosses England near the parallel of 54°, passes across the Gulf of Bothnia near the Walgrund Islands, almost 9° further north; and the whole of the Baltic proper, with the Gulf of Finland and the southern part of the Gulf of Bothnia, lies between the July isotherms of 60° and 65°. Thus the range between the *mean summer* and *mean winter* temperatures, which is only about 20° in the British Islands, is about 40° over the Baltic area. The *mean annual* temperature of the Gulf of Bothnia ranges between 30° at its northern extremity and 40° at its southern, while that of the Baltic ranges from 40° at its northern boundary to about 46° at its southern.

Formation and Transportation of Ice.—The greater part of the Gulfs of Bothnia and Finland is usually frozen over during the winter, the formation of ice beginning at the head and extending downwards. Masses of ice, conveyed by the currents into the Baltic proper, freeze together as the winter advances, and form vast fields, generally extending on the east side as far south as the islands of Dagö and Oesel, and on the west to the south of Stockholm. It happens sometimes, though rarely, that large portions of the Baltic proper are continuously frozen over; but navigation is usually interrupted by the blocking up of its bays and harbours with ice, from the latter part of December to the beginning of April. The freezing of the Gulfs of Bothnia and Finland begins earlier and ends later.

The curious phenomenon of the *formation of bottom-ice*, and its rise to the surface, is more frequently seen in the Baltic and the Cattegat than in the open ocean,—chiefly, it seems probable, on account of the shallowness of these seas. It has been particularly observed by Prof. Nilsson in the Cattegat, off Kullen Point, near the southern extremity of Sweden; but according to Chydenius it is very common in various parts of the Baltic, having been especially noticed by the fishermen off the Åland Islands. In calm winter weather, water of from 4 to 8 feet deep is often covered in a very short time with small plates of ice, mostly circular in form, varying in diameter from 1 to 5 inches, and having a uniform thickness which never exceeds two lines. These plates can be seen coming up from below, rising edgeways towards the surface, often with such force as to lift themselves three or four inches out of the water. When they come up in great numbers they are often piled one upon another, and are then usually soon broken, by the action either of waves or of currents, into small pieces, which unite again by regelation so as to form irregular cakes of ice; and these, as soon as the water becomes tolerably still, cohere into a continuous rough sheet. But it sometimes happens that if the plates come up more sparsely, and the weather is very still and cold, they remain unbroken, and the diameter of each increases, sometimes to two feet or even more. When the fishermen notice these ice-plates coming up from below in large quantities, they at once make for land, as they know that they might otherwise be soon com-

pletely ice-bound. The same thing appears to happen in polar seas in the shallow water near land. Chydenius, who was a member of the Swedish Spitzbergen expedition in 1857, states that on one occasion the surface of the sea, which was previously quite clear of ice, became so covered in the course of half an hour, that it was with difficulty that a boat could be forced through it; and this although the temperature of the air during the day had not been lower than 4° C., and no wind or stream had brought the ice together.

It does not seem very clear in what way this formation of bottom-ice is to be accounted for. Bottom-ice has often been noticed in fresh-water lakes and streams; and large plates have been seen to rise to the surface, sometimes with force enough to bring up stones of considerable size,—in one instance a heavy iron chain. In these cases it would seem that the motion of the bottom-water over roughened surfaces contributes to its congelation. And in the shallow water near the sea-shore, stones and sea-weeds may be seen covered with ice, like the hoar-frost on trees, before any ice forms on the surface. It is to be remembered that *sea-water* increases in density down to its freezing point, so that the water cooled at the surface will always go down, the deepest stratum being thus the coldest. And thus, although no lower temperature can be carried down by the water than that to which it has been subjected at the surface, the water that does not freeze at (say) -2°·5 C. when lying upon water, changes into ice when it comes in contact with the irregular solid bottom, perhaps on account of the more ready dissipation, under the latter circumstances, of the heat set free in the act of congelation.

When ice forms over the shallow bottoms which border parts of the Gulfs of Bothnia and Finland, large blocks of stone are frequently frozen into it; and these, being lifted when the water rises in the early summer, are often transported by currents to considerable distances, finally subsiding again to the bottom when the ice melts. In this manner a deposit of rocky fragments, some of them 6 or 8 feet across, is being formed at the bottom of the Baltic outlets; as is known from the fact, that sunken ships which have been visited by divers in the Sound and in Copenhagen roads have been found covered with such blocks within no very long period. It not unfrequently happens, moreover, that sheets of ice with included boulders are driven up on the coast during storms, and are thus carried some way inland, being sometimes packed to a height of even 50 feet. A case was described by Von Baer in which a block of granite, whose weight was estimated at between 400 and 500 tons, was thus carried by the ice during the winters of 1837-8; and Forchhammer mentions that the Sound being suddenly frozen over during an intense frost in February 1844, sheets of ice driven by a storm were heaped upon the shore of the bay of Tjäreby, and frozen into one mass so as to form a mound more than 16 feet high, which threw down the walls of several houses, and left behind it ridges of sand and pebbles when it thawed. It is apparently, moreover, by similar agencies, that the fringe of rocky islands of all dimensions called the *Skär*, which lies at a little distance from the shore of many parts of the Baltic, is being gradually modified. Boats and small vessels can sail in smooth water within this *skär*, even when the sea outside is strongly agitated; but the navigation is intricate, and the danger from sunken rocks to those not thoroughly acquainted with it is very considerable. The diminution which has been noticed from time to time in the depth of the channels, and the appearance above water of what were formerly regarded as sunken rocks or reefs, have been regarded as concurring with other evidence to prove that a general rise of land is now going on over this area. But it seems probable from what has