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observed by me on the spot have been thoroughly sifted and published. So with all these tasks and responsibilities before me, I can at present cherish no more eager wish than that my efforts to secure an adequate record of the results may be successful, and that I may thus be able to do to the end what I feel is my duty to science.

THE DEVELOPMENT OF THE INLAND WATERWAYS OF CENTRAL EUROPE.

By H. J. PEDDIE.

WHATEVER value and importance this country may attach to its inland waterways, there cannot be any doubt that other nations attach the greatest importance to theirs, and are straining every nerve to bring them into a state of the utmost utility and greatest perfection. Canada, which has already an excellent canal system, is about to spend £20,000,000 sterling on the construction of the Georgian Bay Canal, which will open up the great lakes to ocean-going steamers. The United States of America, which also possess an extensive and valuable system of inland waterways, in addition to the gigantic commitment on the Panama Canal, is contemplating spending £100,000,000 sterling in the formation of another gigantic system, about 5000 miles in circumference, and tapping an area of 1,400,000 square miles—a project which, if fully carried out, will increase the length of the waterways in the Mississippi valley from 16,000 to 45,000 miles. France, which possesses one of the finest systems of waterways in the world (11,000 miles in length), which has cost about £120,000,000 sterling during the last forty years, has also schemes of great magnitude for further extensions.

But it is more particularly to what Germany and Austria are at present engaged upon that I desire to direct special attention. The coasts of Germany are mostly shallow, bleak and inhospitable, devoid of good natural harbours, and with long stretches of dreary sand and mudbanks, and flat, swampy shores, very liable to silting up. This, no doubt, is a protection against the too close approach of a hostile fleet, but it is a decided disadvantage in the case of the mercantile marine, and in the case of their own warships seeking safety from an enemy in their harbours, and in repairing to their docks for refitting. Moreover, the coal and iron districts of Germany lie from 400 to 800 miles inland from the coast. On the other hand, Germany possesses a number of good rivers, which only require to be improved artificially, and linked together, in order to furnish the Fatherland with a magnificent system of inland waterways, of incalculable advantage to the commerce and the manufactures of the Empire. Both the German Government and the nation thoroughly realise the supreme importance and value of their river system as a great national asset, and they have set themselves with great skill, resolutely and systematically, to develop their rivers to their utmost

value, and to unite them into one grand national system of inland waterways, which will link every part of the Fatherland together in a very effective manner.

As is well known, the Kaiser Wilhelm Canal is being enlarged so as to permit of the passage of large warships, at a cost of £12,000,000 sterling. In addition to this, it is intended to connect the mouth of the Elbe by canal with Jade Bay, on which Wilhelmshafen has been constructed, and this project has already been carried out so far as Bremerhafen, and the Canal is to be extended through the neck of land between Bremerhafen and the Jade. When the project is completed the three canals will form a curved inland waterway from Kiel, on the Baltic, to Emden, on the North Sea, of great advantage to the mercantile marine, and invaluable in time of war as a naval base from which to operate either in the North Sea or in the Baltic.

But to come to the proper subject of this paper, the inland river system of Germany: this comprises five great trunk routes, leading from the North Sea and the Baltic right through the country to the southern boundary of the Empire, the general trend of which, notwithstanding various turnings and twistings, is in a south-easterly direction. These are now being converted, at great cost, into one fine system of first-class waterways, and they are also being linked together, from west to east, by a cross-country system of waterways running from the Ems, on the extreme west, to the Vistula and the Dnieper on the extreme east, roughly parallel with the northern coast-line. It will thus be seen that the country is being covered with a network of admirably planned and skilfully executed inland waterways, partly natural and partly artificial.

Let us examine the various routes in detail, beginning with the most westerly, the Rhine route, which runs from the North Sea to Switzerland, and with its tributary, the Main, also reaches Bavaria. The Rhine, however, debouches into the North Sea through Holland, and Germany has resolved to secure an entirely independent access to the North Sea through her own territory. She has therefore improved and canalised the river Ems from Emden on the coast to Dortmund, and there connected the Ems with the Rhine by the Rhine-Ems Canal. This route is being made of a uniform depth with the Rhine, so that barges of even 3000 tons can pass over it. Germany thus possesses an outlet from the Rhine to the North Sea entirely within her own territory. Dortmund is being provided with harbour works of greater extent than those of Hamburg, and Emden is being provided with the most modern and up-to-date appliances for the efficient and economical handling of traffic.

Frankfurt-on-the-Main is spending from £2,500,000 to £3,000,000 sterling on modern and up-to-date docks, and above Frankfurt the river is being deepened as far as Aschaffenberg, and canals are to be made to link up at Bamberg and Nürnberg with the Ludwig Canal, which connects with the Danube. Mannheim, 160 miles higher up the Rhine than Cologne, has constructed a first-class set of docks and quays, and contemplates a further extension of these.

Then Switzerland has resolved to develop a maritime commerce from

Basel *via* the Rhine and Holland, and it was intimated last year that a steamer was to run between Basel and London. Not content with this, they have a project to link the North Sea with the Mediterranean, the details of which I am not at present in a position to furnish. When the Ems-Rhine-Main route is completed, Germany will possess a great national inland water highway, traversing a rich, populous, manufacturing, mining, and commercial district, and reaching from the North Sea to the highlands of Switzerland on the one hand, and through the Danube to the Black Sea on the other hand, whilst it is probable that, ultimately, it may reach the Mediterranean through the Swiss rivers and their connections.

The second route to be noticed is that of the Weser, with its great port of Bremen, which city has plans for a new town, a canal and docks, and a great industrial centre, to be carried out at vast expense. The Weser is navigable as far as Münden, and its tributary the Fulda has been canalised as far as Cassel. About half-way between Emden and Dortmund a canal runs at right angles connecting the Weser with the Ems-Rhine route, and it is also to be connected, as will hereafter be described, with the other three more easterly trunk routes.

Passing still farther east, we reach the Elbe, 75 miles from the mouth of which stands Hamburg, the first sea-port of Germany, and by far the most important port in Continental Europe. The Elbe, which discharges into the North Sea, and also connects with the Baltic Sea by the river Trave, penetrates to Austria, and connects with the Danube above Dresden. Within the Austrian territory it is to be canalised so as to afford easy access to Saxony, the Rhenish districts, and the North Sea. The up-and-down river traffic on the Elbe, between the Bohemian frontier and the sea, is given at considerably over 23,000,000 tons annually. The great value to Germany of this inland waterway will be easily realised. But further, last year a plan was sanctioned by Schleswig-Holstein for a canal from the Elbe to Kiel.

Going still farther east, we reach the Oder, on which lie the three important cities of Stettin, Frankfurt, and Breslau. This river, which reaches from the Baltic to Austrian territory, is to be canalised at the cost of £1,000,000 sterling from south of Frankfurt, particularly above Kosel in Silesia, to Oderberg on the Austrian frontier. Then from Oderberg a most important waterway connection, more generally known as the Danube-Oder Canal, but which the Austrians prefer to designate the Black Sea-Baltic Canal, is being made in order to link up the Oder and the Danube, the Elbe, the Vistula, and the Dnieper rivers, and is designed to give passage to ships up to 600 tons burthen. This important project, which was sanctioned in 1901, and which is to be completed before 1924 at an estimated cost of £34,400,000 sterling, consists of six canals, with a total length, in the complete system, of 1600 kilometres. The Danube-Oder scheme proper is an old one, and is a rival scheme to the Russian project, originated some fifty years ago, for linking up the Baltic and the Black Sea by connecting the Dwina from the Gulf of Riga with the Dnieper, which flows into the Black Sea near Kherson.

In 1702 Leopold I. of Austria ordered the improvement of the river March, which flows south through Moravia, near the German frontier, and falls into the Danube not far from Pressburg. Some seventeen years later plans were made for connecting the river Becza, a small tributary of the March, with the Luhabach, a small tributary of the upper Oder, and this is virtually the scheme presently being carried out. At various times different schemes have been brought forward to effect the necessary junction, such as the 1873 project for a canal with five locks, a French scheme for seven ship railways, another scheme for a lockless canal, and one for a ship railway, but all came to nothing.

Near the Moravian town of Weisskirchen the Becza and the Luhabach approach within $19\frac{1}{2}$ kilometres of each other with a dividing watershed of 43 metres in height. According to the scheme begun in 1908, and now being steadily pushed forward, the watershed is to be pierced with a tunnel, and a canal formed from the Oder *via* the Luhabach, the tunnel, the Becza, and the March, to the Danube. When completed this will give a through inland waterway, 2700 kilometres in length, between the Black Sea and the Baltic, giving passage, as above stated, to vessels up to 600 tons burthen. Vienna will then become a somewhat important inland port, having water communication with the North Sea, the Baltic, and the Black Sea, with various parts of the German Empire, with Western Russia and the Balkan States, as well as with Austrian territory proper. The cost of the Danube-Oder Canal is estimated at £12,000,000 sterling, and as the traffic at first is only estimated at from 60,000, to 70,000 tons per annum, the importance which Austria attaches to the project can readily be gauged. She anticipates from it a large import of Silesian coal to be used in preference to her own brown Bohemian coal, and also a growing traffic in timber, grain, and sugar, reaching to the very heart of her own territories. She will also be able successfully to compete with German manufacturers on their own ground in a considerable portion of Germany. Strategic advantages, as will be pointed out hereafter, also weigh with her. It will be interesting to see the result of the construction of the ship-canal tunnel, which may have an important bearing on other similar canals.

Again, the Oder is connected with the Havel and the Spree by the Friedrich Wilhelm Canal, and at a cost of over two millions sterling a canal, of sufficient size for large vessels, is being made from Stettin to Berlin, which will convert the latter city into a first-class inland port, with a waterway connection very similar to that which its rival Vienna will also possess when the various projects contemplated are completed.

Finally, we reach the fifth trunk route, the Vistula, reaching from the Baltic through Prussia and Poland to Austria, and having lying on it the three large and important cities of Dantzic, Warsaw, and Cracow. As has just been stated, the Vistula is to be linked up on the west with the Oder and the Danube, by the Danube-Oder Canal, from which a connection with the Elbe can easily be effected, and on the east with the Dnieper river, thus getting direct access to the Black Sea and Odessa.

Let us now look at the cross-country connection being formed between the above five trunk routes, beginning again at the western end. As

before stated, the Rhine has been connected with the Ems by the Rhine-Ems Canal. Then half-way between Emden and Dortmund the Ems is connected by a canal with the Weser, and this canal is to be carried, *via* Hanover and Berlin, to meet the Oder near Frankfurt. A connection, costing one million, is being carried out between the Oder and the Vistula, and from the Warthe to Posen, and, as before said, the Vistula is to connect with the Dnieper.

The cost of all these great undertakings I have not been able to ascertain, but from the information available it may safely be taken as not under sixty to seventy millions sterling, and most probably a great deal more. Many of the canals, etc., will never yield any return in the shape of interest on the capital sunk in them; but the enormous benefit that will accrue from them to the commerce and manufactures and the agriculture of the countries can hardly be overestimated. The two empires will be penetrated by them from the sea to their most inland districts. The great industrial centres will have cheap and easy access both to the coasts and to the various parts of the two empires and the adjoining countries with which the empires have thus been linked. Berlin and Vienna and other large cities will become considerable inland ports, with excellent waterways to both the northern and the southern seas, and to the most inland districts of the two countries. The various routes which have been described will in course of time be linked with the inland waterways of Belgium, France, and other parts of Russia, and it is impossible to forecast the resulting development of the commerce which will thus be created between the various countries.

But these waterways are also destined to play an important part in the national defences of Germany. The advantages of the Kaiser Wilhelm Canal and its extensions to the Jade, have already been referred to. Then as regards the inland waterways, if Germany was at war with a great naval power, even if her fleets were destroyed and her flag disappeared from the high seas, she could still with perfect safety and ease carry on through her inland waterways a very great commerce with Denmark, Holland, Switzerland, Austria, and Poland, and when the necessary connections are made, with Belgium, France, and Russia, in addition to that on her railways and roadways.

Numerous dry docks and slips are also being built in Germany in connection with the waterways, which will therefore play no small part in the national defences of the Fatherland.

In closing, it may not be out of place to call attention here to the important fact, that in Austria and other Continental countries the question of the international consumption of water and the State control and allocation of the national water resources, is being dealt with, as it will soon require to be dealt with in Britain. How important this matter is may be gathered from the following facts. From an investigation by "the National Conservation Commission" of the United States of America, it appears that 215 trillion cubic feet of rain falls in the States annually, of which rather more than one-half is evaporated, about one-third flows in rivers to the sea, the remainder being either used or absorbed in plant growth or other chemical action, or permeating

deeper, and reaching the sea subterraneously. Benefit accrues from what is evaporated, but of the third which flows to the sea less than one per cent. is utilised by the community. In arid regions about 10 per cent. is used for irrigation purposes, and it is estimated that 5 per cent. is used for navigation and 5 per cent. for power, the water used for navigation and for power being in many cases the same. More than 85 per cent. of the surface water flows unused to the sea. The waste and loss to the country, from this state of matters, is obvious. It would be interesting and instructive to learn how the matter stands in the United Kingdom.

THE DISTRIBUTION OF THE TOWNS AND VILLAGES OF SCOTLAND.

By JAMES COSSAR, M.A.

(Continued from page 191.)

2. HISTORICAL ASPECTS OF THE QUESTION.

IN his papers dealing with the distribution of the towns and villages of England, Mr. Chisholm has pointed out that the origin of several of the present centres of population can be traced to Roman times. The Roman conquest of the country lying to the north of the Tweed was clearly of a much less permanent nature, for no Scottish town or village can with absolute certainty be said to have taken its rise as a Roman settlement. It has been possible to trace the course of one or two roads which were probably made by the early invaders; and the position of Antonine's wall shows that they fully appreciated the valuable line of defence afforded by the geographical conditions of this part of the country. Roman remains have been unearthed at Birrens, in Dumfriesshire, at Newstead, near Melrose, at Ardoch and Inchtuthill in Perthshire, some of which seem to mark the site of ancient military settlements. Inveresk may have been a Roman station, and the bridge at Musselburgh is generally credited with a Roman origin. Cramond and Dumbarton are supposed to occupy the sites of Roman seaports, while another may have existed on Carron Water near the present Camelon. But with the scanty material at our disposal it is not yet possible to determine either the extent of the Roman invasion or its effect upon the development of the peoples north of the Tweed, and the entire absence of Roman place-names in the country would seem to indicate that the influence of their occupation was less enduring and pervasive than in the southern part of the kingdom. Nor can it be said that we have much more definite information about the condition and distribution of the population for several centuries after the final withdrawal of the Roman forces. The attempt to locate the scenes of the Arthurian romance in our own country is interesting, but scarcely of importance for our present purpose.