SWEDEN

Part I.—Geography and Statistics.

SWEDEN comprises the eastern and southern divisions of the Scandinavian peninsula. Its northern extremity, Kuokimodka, is situated in 69° 3′ 21″ and the southern in 55° 20′ 18″ N. lat. The western extremity (on the Cattegat) lies in 11° 6′ 29″ and the eastern (on the frontier of Finland) in 24° 10′ E. long. The greatest length of the country from north to south is 986 miles and its greatest breadth 286 miles, and the area is 170,713 square miles. The length of the coast-line is 1603 miles, the length of the boundary line towards Norway 1019 miles, and that of the boundary line towards Finland 305 miles.

Sweden is divided into three chief parts,—the southern being called Götaland, the middle part Svealand or Sweden proper, and the northern Norrland. The north and north-west parts of Norrland are called Lapland.

The frontier towards Norway, from 69° to 63° N. lat., is formed by a continuous mountain range called Kölen (the keel). The snow peaks of Sulitelma (6178 feet), east of Saltenfjord, on the frontier between Sweden and Norway, were long supposed to mark the highest elevation of this mountain chain, but the geodetical survey now in progress in western Lapland has already shown that there are at least two peaks whose height exceeds that of Sulitelma, viz., Kefnekaise (7008 feet) and Sarjektjåkko (6988 feet).

In this mountain range (Kölen), rise a great number of rivers and streams, which flow in a south-easterly direction to the Gulf of Bothnia. The immense quantity of fresh water that is thus carried into the gulf makes its water scarcely more salt than that of a lake (0·25 to 0·40 per cent. of salt). Between the upper courses of the rivers the watersheds consist of mountain ridges, which gradually diminish in height. The intermediate valleys are for the most part filled with the water of the rivers, and thus form a number of lakes at a considerable elevation above the sea-level. Issuing from these lakes, the rivers form great cataracts, and afterwards flow through the level plain that forms the coast-region of the Gulf of Bothnia for a distance of many miles from the shore.

The boundary between Sweden and Finland is formed by (1) Muonio Elf, and afterwards by (2) Torneå Elf, into which it flows; Torneå Elf rises in Torneå Träsk, at an elevation of 1132 feet above the sea. Then come, in order along the coast, the following rivers:—(3) Kalix Elf, which in its upper course forms the lakes of Paitas Jaur and Kalas Järvi;[1] (4) Stora Luleå Elf (242 miles), which forms Stora Luleå Jaur (1214 feet) and receives on the right (5) Lilla Luleå Elf, which forms the lakes of Saggat Träsk and Skalka Jaur (984 feet); (6) Piteå Elf, with the lake of Tjäggelvas; (7) Skellefteå Elf, forming a number of great lakes, such as Hornafvan (1391 feet), Uddjaur (1375 feet), Storafvan (1371 feet); (8) Umeå Elf (261 miles), with a great number of lakes, of which the largest is Stor-Uman, receives on the left a tributary of almost equal size, viz., (9) Vindel Elf; (10) Ångerman Elf (211 miles), which receives the water of a whole system of streams and lakes, the largest of the latter being Ströms Vattudal, in the south of Lapland; (11) Indals Elf, which receives the Ammerå, with its tributaries and the numerous emissary lakes, as Hotagen (1017 feet), Kallsjön and Storsjön ("Storsa Lake" on the map) (958 feet, area 173 sq. miles). Close to the railway from Trondhjem to Östersund, between Kallsjön and Storsjön, rises the peak of Åreskutan (4652 feet), which is ascended every year by a great number of tourists, and in the vicinity many sanatoria are situated. Farther south flow three large rivers:—(12) Ljungan (193 miles), with Holmsjön (656 feet); (13) Ljusnan (249 miles); and (14) Dal Elf (286 miles), which passes through Särnasjön (1450 feet) and Siljan (541 feet, 110 sq. miles), and receives on the right (15) West Dal Elf. The last-named four rivers rise in a mountainous region with many high summits, which are the eastern outposts of the high range of Dovrefjeld, which traverses Norway from west to east, between the parallels of 67° and 63° N. lat. Among these summits, situated on the frontier or in Sweden, are to be observed the Syltoppar (5865 feet), Son Fjell (4190 feet), Helags Fjell (5900 feet), and Städjan (3860 feet) on the north shore of Särnasjön.

In Norway, not far from the sources of Dal Elf, lies the lake of Fämundsjö, which gives rise to (16) Klar Elf, which flows southwards to Lake Vener, the largest lake in Sweden (144 feet, area 2150 square miles). The outlet of Vener is (17) Göta Elf, which falls into the Cattegat, near Gothenburg. The watershed between Dal Elf and Klar Elf is a wooded range of hills without high peaks, sloping to the south-east. The south-eastern part of Svealand comprises the water systems of the large lakes of Hjelmar (75 feet, area 185 square miles) and Mälar (area 449 square miles). Lake Mälar discharges into the Baltic at Stockholm by two outlets—(18) Norrström and Söderström. They are, however, almost to be regarded as channels or sounds, rather than as streams, the difference of level between Lake Mälar and the Baltic being so small that occasionally, when the water is low in Mälar and high in the Baltic, the current sets from the latter into the former. Lake Mälar may thus be considered a fjord of the Baltic. Still its waters are kept fresh by the great number of small streams that discharge into it, the most important of these being (19) Fyris Elf, which passes Upsala.

The boundary between Svealand and Götaland consists of wooded heights. Between Lake Vetter and the northern shore of Bråviken Bay stretches the forest of Kolmorden, and between the northern extremity of Lake Vetter and Lake Vener lies that of Tiveden. Lake Vetter (290 feet, area 733 square miles) discharges itself into Bråviken by (20) Motala Ström, the falls of which are utilized for the mills in the town of Norrköping, near the mouth of the river.

The central part of Götaland consists of an extensive tableland or plateau, of which the highest part, at an elevation of 1237 feet, lies somewhat to the south of Vetter. On the north this plateau descends rather abruptly towards the fertile plains of Östergötland (drained by Motala Ström) and Skaraborg län, between Vetter and Vener. Near the south-eastern shore of Vetter, a little to the north of Jönköping, lies Mount Omberg (863 feet), and near the southern shore of Vener, close by Lidköping, lies Kinnekulle (915 feet), both hills remarkable for their beauty. The great plateau descends less abruptly towards east, south, and west. A great number of lesser streams flow down its slopes. The principal are—(21) Emmån, which falls into Calmar Sound; (22) Lyckebyån, (23) Mörrumsån, and (24) Helgaån, which flow in a southerly direction; and (25) Lagan, (26) Nissan, (27) Ätran, and (28) Viskan, which fall into the Cattegat. On this great plateau and its slopes lie also many lakes. In the northern part, east of Vetter, lies Sommen (479 feet), and farther north Boren, Roxen, and Glan. Between Vetter and Vener lies Unden (384 feet). On the summit of the plateau lies Ekelsjö (1132 feet), and on its southern slope Helgasjö (535 feet), Bolmen (466 feet), Möckeln (446 feet), and Åsnen.

The southmost part of Sweden, Skåne, consists for the most part of a low fertile country. Only in the northern part, Christianstad län, occur two low stretches of hills, called Linderödsåsen and Söderåsen.

Waterfalls.—The largest waterfalls are—(1) Njuommelsaska (Harsprånget), in Storå Luleå Elf, with a breadth of 60–70 feet, consisting of two cataracts of 103 feet at the upper end and a fall of 150 feet more in the course of 1¼ miles,—the largest waterfall in Europe; (2) Ådna-Muorki-Kortje ("the great fall of the lake"), on the same river as the former, higher up, between the two lakes Jäntajaur and Kaskajaur, has a fall of 130 feet, of which 100 feet are one perpendicular cataract; (3) Tännforsen, 12 miles west of Åreskutan in Jemtland, between Tännsjön and Noren, has a breadth of 160 and a perpendicular fall of 84 feet; (4) Trollhättan, in Göta Elf, consists of three successive falls having a total height of 100 feet.

Character of surface.

It will be seen that, with the exception of the north-west part along the Norwegian frontier, Sweden is not a mountainous country. On the other hand, fertile plains are not frequent. The most extensive are the north-west shore of the Gulf of Bothnia, where, however, the severe climate precludes any successful agriculture, the water districts of Lake Mälar and Lake Hjelmar, the rich agricultural district of Östergötland between Vetter and the Baltic, Vestergötland, or the whole country between the two great lakes as far as Gothenburg, and, as has been just mentioned, the southmost part, or Skåne, which comprises Christianstad and Malmöhus län. The greatest part of the country consists of low hills of granite or gneiss, clothed with forests of pine and fir. The valleys are generally in great part filled with water, and the shores of their lakes or wide rivers are covered with forests of deciduous trees, chiefly birch, or consist of arable soil. With the exception of Finland there is no country so full of lakes as Sweden. Nearly one-twelfth of the whole surface of the country, or about 13,900 square miles, is covered with water.

Coast.

Coast.—The coast of Sweden is not broken by so many or so deep fjords as that of Norway. The most considerable indentation is the above-mentioned Bråviken Bay. On the other hand, the Swedish coast is, perhaps in a still greater degree than the Norwegian, fringed by innumerable little islets. Except on the coast round Skåne, in the south, the mainland does not come into direct contact with the sea, girdled as it is by a belt of islands, holms, and skerries, more or less thickly set, which forms the so called "skärgård" fence of skerries or outer coast. Between this wall of islets and the mainland, therefore, extends a connected series of sounds of the greatest importance for coastal navigation, since they admit of the employment of vessels of less size and strength. This skärgård forms, besides, a most valuable natural defence; for, while some sounds are deep, navigation in the vicinity of the coasts is, as a rule, practically impossible without the help of pilots.

The "skärgård."

The broadest part of this skärgård is that off Stockholm, which stretches many miles out into the Baltic. It consists of a few large and well-peopled islands, surrounded by many hundreds of islets, for the most part uninhabited. The outer islands are bare grey rocks of gneiss, but the inner ones are mostly covered with fir and birch trees. The entrance to Stockholm through this archipelago is of its kind one of the most curious and picturesque in the world. The largest of these islands are Ljusterö, Vermdö, Ingarö, Vindö, Runmarö, Ornö, and Utö (with rich iron mines). As mentioned above. Lake Mälar is to be considered as a fjord of the Baltic. The skärgård also extends into Mälar, which is filled with islands. The most remarkable is Björkö, where the old town of Birka was situated. The archæological researches on this spot have been of the greatest importance for our knowledge of life in Sweden in the times of the vikings. The part of the skärgård next in breadth is that off Carlskrona, where the islands of Sturkö, Tjurkö, Aspö, and Hasslö are situated.

The Cattegat skärgård, which extends from the fjord of Svinesund at the southern extremity of the Norwegian frontier as far as Halmstad, has a different aspect from that of the Baltic. In the Cattegat all the islands, as well as the rocks of the mainland, are almost bare of vegetation. Trees are quite absent in most places, and generally the grey rocks are not even covered with grass or moss. They look as if they were polished by the sea. Between these bare rocks there is, however, in many places even on the larger islands arable soil of great fertility. In the northern part of the skärgård near Strömstad lie the larger islands of Sandö, Ödö, Tjernö, Rösö, &c. Farther seawards lie the Koster Islands and the Väder Islands with their lighthouses. A little more to the south, in the vicinity of Lysekil, are three narrow fjords—Åbyfjord, Gullmarfjord, and Koljefjord. Off the first-named lies Malmö,[1] remarkable for its quarry, where the fine granite of which the island consists is wrought. Next come, in succession, Kornö, Skaftö, Flatö, Hermani and Lyrö, the last two situated off the two largest islands on this coast, Oroust and Tjörn. All the islands now enumerated are surrounded by innumerable islets and rocks. South of Tjörn there are no considerable islands except Marstrand (with a small town and much-frequented sea-bathing quarters), Koö, and Klöfverö, all situated immediately to the south of Tjörn. On the coast of Halland we find only Särö, off the fjord of Kungsbacka, and the Väderö of Halland, off Torekow, between Laholm Bay and Skelder Bay, the only islands on the whole coast that are covered with a rich vegetation of trees. On the extreme point of the cape, between the latter fjord and the Sound, lies the isolated Mount Kullen with its lighthouse. In the Sound off Landskrona lies the islet of Hven, where Tycho Brahe had his observatory, Uranienborg, in the end of the 16th century (1576–1597).

Large islands.

In the Baltic lie the two great islands of Gotland and Öland, of which the former is itself a county and a bishopric. These islands are quite different from the Swedish mainland. They are formed of Silurian limestone. On the western coast of Gotland the limestone rocks descend precipitously into the sea, and the island forms a comparatively smooth plateau, which slopes gradually to the east. The limestone soil is very fertile, and trees and plants thrive on it that do not otherwise grow in the climate of Sweden, such as walnuts, ivy, &c. The case is the same in Öland. This island somewhat resembles a house-top. A sterile limestone plain (Alvaren) stretches the whole length of the island from north to south, and from this the country slopes both towards Calmar Sound on the west and towards the Baltic on the east. The slopes, especially the western, are very fertile.

Sea-Bed.—The seas that surround Sweden are remarkably shallow. Round the south part of Norway runs a depression in the sea-bed, called the Norwegian Channel (see Norwegian Sea). It stretches along the west and south coasts of Norway southward and eastward almost to Christiania Fjord and the Cattegat. The deepest part of this channel, upwards of 400 fathoms, extends through the Skagerack between Arendal in Norway and the Scaw. In the Cattegat the depth diminishes abruptly, and

[1] The word for "lake," which is *sjö* or *träsk* in Swedish, is *jaur* in Lapponian, and *järvi* in Finnish. "River" is *elf* in Swedish.

[1] Not to be confounded with the town of Malmö in Skåne.

between Gothenburg and the Scaw the greatest depth is between 33 and 55 fathoms. The greatest part of the southern half of the Cattegat has a depth of less than 30 fathoms. The depth of the Sound generally is even less than 12 fathoms. The whole southern part of the Baltic between Sweden and Germany is very shallow. West of Bornholm the depth nowhere reaches 30 fathoms. East of Bornholm the sea is somewhat deeper, and a small area of a depth of 50 to 60 fathoms is found a little east of that island. The whole of that part of the Baltic which lies between Sweden and Russia is divided into two separate basins by a submarine bank. From the southern extremity of Gotland (Hoburg) there extends a nearly uninterrupted bank to the south-west as far as the Prussian coast. The depth on this bank nowhere reaches 30 fathoms. The shallowest parts are Hoburg Bank south of Gotland, Mittel Bank south-east of Öland, and Stolpe Bank off the Prussian coast. Between Färö off the north coast of Gotland and the Gottska Sandö there extends a similar bank, which continues with a somewhat greater depth of about 30 fathoms as far north as Stockholm. The deepest part of the Baltic between these banks is situated in the north part between Landsort and the Gottska Sandö, the maximum depth being about 160 fathoms. Ålands Haf, the channel between the Swedish coast and the Åland Islands, is tolerably deep (100 to 160 fathoms).

The Gulf of Bothnia is divided into two basins by the channel of Qvarken; the southern is the deeper (about 50 fathoms), and the depth increases towards the north-west, where, over a small area off the island of Ulfö near the Swedish coast, it reaches 160 fathoms. The channel of Qvarken is very shallow (8 to 16 fathoms). The basin on the north side is also shallow. Only over a small area off Bjurö Cape does the depth exceed 160 fathoms.

Climate. *Climate.*—Sweden is situated between two countries of very different climatological conditions. On the west there is the maritime climate of the Norwegian coast, and on the east the continental climate of Russia. It may be said that Sweden alternates between the two. Cold winters alternate with mild ones, and warm and dry summers with cool and rainy ones. But different parts of Sweden have also in this respect a greatly differing climate, of which we readily see the reason if we only recollect the character and the general features of the configuration of the country. Lapland and the western part of the country along the Norwegian frontier have a pronounced continental climate, and so has the high plateau to the south of Lake Vetter. On the other hand, the climate is more maritime the more we approach the coasts of the Baltic, and on the coast of the Cattegat and in Skåne the maritime climate distinctly predominates.

Temperature. The following table gives the mean annual temperatures (Fahr.) at twenty-eight meteorological stations in Sweden, together with the means for January and July:—

Station.	Annual.	Jan.	July.	Station.	Annual.	Jan.	July.
	°	°	°		°	°	°
Lund	44·9	31·3	61·7	Örebro	41·6	25·8	62·6
Carlshamn	44·4	31·1	61·7	Stockholm	41·4	26·1	61·4
Calmar	44·2	30·2	62·1	Carlstad	41·6	24·9	62·9
Halmstad	44·8	30·3	62·7	Westerås	41·9	24·7	62·6
Vexiö	42·3	27·5	61·2	Upsala	40·4	24·5	61·5
Visby	43·4	30·7	60·3	Falun	38·7	20·8	61·2
Gothenburg	44·4	29·8	62·1	Gefle	40·0	24·3	61·9
Vestervik	42·8	28·1	61·4	Hernösand	37·1	20·0	58·9
Jönköping	42·7	28·6	61·0	Östersund	36·0	15·3	56·4
Venersborg	42·3	27·5	61·1	Umea	34·4	15·8	55·6
Skara	41·5	26·9	60·3	Stensele	31·7	9·5	57·7
Linköping	43·4	27·8	63·9	Pitea	33·8	11·2	60·6
Nyköping	41·5	26·6	61·4	Haparanda	31·9	10·1	59·4
Askersund	41·0	25·1	61·2	Jockmock	29·1	2·1	53·0

From these figures it appears that, as mentioned above, the climate is most continental in the northern and interior parts of the country, especially at the two stations of Lapland, Stensele and Jockmock, while it is more maritime on the coasts. For this reason the isotherms for January on the Scandinavian peninsula are linguiform. The warm sea off Norway causes the peculiarity that the western parts of Lapland, although situated at the greatest elevation above the sea, have not so cold winters as the interior parts round the great lakes. Still farther to the east the temperature increases again towards the coast of the Gulf of Bothnia. Thus, for example, the isotherm of 10° F. enters Lapland from the north-east at about 68° N. lat., runs towards the south-west over the great lakes as far as about 64½°, south of Lake Stor-Uman, makes there an abrupt bend towards the east, and runs in a north-easterly direction to Haparanda at the northern extremity of the Gulf of Bothnia. The isotherm of 23° F. runs from the great lake of Mjösen in Norway, north of Christinia, to the southern shore of Lake Siljan, or almost straight east, curve there to the north-east, and reaches the shore of the Gulf of Bothnia a little north of the mouth of Ljusnan. Finally, the isotherm of 30° runs from Gothenburg towards the south-east to the lake of Åsnen, curves towards the north-east, and passes Calmar and the northern parts of the islands Öland and Gotland. On the summit of the plateau south of Vetter the mean temperature is of course lower than both north and south of the plateau. In July the temperature is almost constant all over the country. With the exception of the interior of Lapland the mean temperature varies generally between 59° and 62°. The warmest point is Linköping on the plain of Östergötland, between Lake Vetter and the Baltic. The most temperate and most agreeable climate of the whole country is that of the Cattegat coast round Halmstad.

A good indication of the climate, especially that of the winter, is Equa- the time during which the freshwater lakes remain frozen. We glacial have seen that nearly one-twelfth of the whole surface of Sweden is covered with water, and in Finland the number of the lakes is still greater. In both countries the times of freezing and breaking up of a great many lakes have been observed for many years. From these data we can calculate the length of the ice periods. If these periods are entered on a diagram, we can draw out the lines of equal ice periods, or the equiglacial lines. The accompanying map shows these lines for Sweden and Finland. From it we see that the glacial period in the southern part of the country is 90 days, while in the northern part of Lapland it has a duration of no less than 230 of the 365 days of the year. The western lakes of Lapland, though the highest in situation, have a somewhat shorter ice period than the eastern. The ice period is considerably lengthened on the great plateau south of Lake Vetter.

Map of Equal Ice Periods.

lines.

We have said above that in certain years the climate of Sweden is more maritime, in others more continental. Thus, for instance, the annual mean temperature of Upsala has varied during the last 30 years between 43°·2 (1859) and 35°·0 (1867). The mean temperature of particular months varies of course in a still higher degree, especially during the winter; thus the mean temperature of January 1873 was 34°·3, but of January 1875 only 12°·2.

The difference between the means of the warmest month and the coldest is the so-called yearly range of temperature. In Sweden July is generally the warmest and February the coldest month. The difference between the January and July temperatures, however, as given in the foregoing table, will show the yearly range approximately. It will be seen that this increases towards the north. For the same latitude, it is greater in the interior of the country than on the coasts.

As is easily understood, the periodic daily range of temperature is least during the darkest part of the year, during December and January, especially in the north part of the country round the polar line, and still farther north, where it is almost nil. The mean range for the whole country is in December only 2°.

maximum occurs in June or July at all stations except those of western Sweden, where it occurs as early as May. The mean of June is 13°. A curious fact is that in Norrland, especially in the interior, a secondary maximum occurs in March, which sometimes even exceeds the summer maximum.

The non-periodic daily range of temperature, or the difference between the monthly means of daily maximum and minimum of temperature, is as usual considerably greater than the periodic. The difference is almost constant for all stations, especially during the warmer part of the year. We have, for the whole country—

	Non-periodic.	Periodic.	Difference.
	°	°	°
Winter	10°·0	3°·0	7°·0
Spring	16°·0	11°·2	4°·8
Summer	19°·1	13°·0	6°·1
Autumn	11°·7	6°·3	5°·4

The mean direction of the winds shows little variation during different seasons. During the summer it is west or west-south-west in the south of Sweden, changes to south-west in the middle part of the country, and due south along the coast of the Gulf of Bothnia. In winter north-north-east winds become comparatively frequent in the north part of the country. This is explained by

Barometer. the difference in barometric pressure in summer and in winter. In July the mean height of the barometer indicates a gradual fall along the coast of the Baltic, from 29·828 inches in Calmar to 29·675 in Haparanda. In January, on the other hand, there is a gradual fall from 29·853 in Calmar to 29·713 in Hernösand, but thereafter a gradual rise to 29·834 in Haparanda. Unfortunately the isobarometric lines for Sweden have not yet been calculated with due precision.

Rainfall. The rainfall is greatest on the coast of the Cattegat. The annual amount is greatest at Gothenburg, where it is 32·56 inches. At Halmstad it is 28·26, and at Venersborg, where Göta Elf issues from Lake Vener, it is 30·33. These are the rainiest stations of Sweden. Generally speaking, the amount of rain diminishes afterwards as well towards north and north-west as towards south-east. The least rain falls on the one hand in northern Lapland, where the annual amount is only 15·52 inches, and on the other hand in the south-eastern corner of Sweden, where (at Calmar) we have the lowest known rainfall for the whole country (12·75 inches). Between these two tracts there runs a belt of greater precipitation from Gothenburg towards the north-east to Upsala, where the annual amount is 23·28. Even along this belt the amount of rainfall diminishes towards the north-east, but at every point the amount is greater than to the north-west and south-east of it. The greatest amount of rain falls in July and August and the least in February and March. Thus, for instance, there fall in Upsala during August 2·86 inches and during March 0·99 inches. As the temperature varies, so does the rainfall for different years.

Thunderstorms. The number of thunderstorms is small in Sweden compared with the countries of the south. Their number diminishes as does the precipitation from south-west towards north and east. From 1871 to 1880 the mean annual number of thunderstorms at each station was 9·5 in Götaland, 8·4 in Svealand, and only 6·3 in Norrland. In the south their number diminishes rapidly from west to east, from 11 on the coast of the Cattegat to 8·3 on the coast of the Baltic, and only 6·6 on the isle of Gotland. The thunderstorms have a distinctly marked annual and daily period. They occur almost always during the warmest time of the year and of the day. During the above-mentioned ten years the least number occurred during the month of February, only 3, whereas there occurred in May 1194, in June 3724, in July 4419, in August 3306, and in September 1461. As regards the daily period, the least number, 147, occurred between 1 and 2 A.M., and the greatest, 1704, between 3 and 4 P.M. In Götaland and Svealand most of the thunderstorms come with a south-westerly wind, in Norrland with a southerly; for the whole country, the least number come with a northerly wind.

If the number of thunderstorms is small in Sweden, the same is in a still higher degree to be said of their intensity. Hail, which on the Continent causes such immense damage to the growing crops, is rare in Sweden, and often quite harmless. In the south of Germany about 2 per cent. of the crops are annually destroyed by hail. At Magdeburg the damage is 0·9 per cent., at Berlin 0·6 to 0·7 per cent., but in Sweden only 0·06 per cent. (H. H. H.)

Geology.—The fundamental rocks of Sweden belong to the Azoic or Pre-Cambrian formation, and consist of crystalline rocks. Three great divisions of this formation may be distinguished,—the grey gneiss, the red iron gneiss, and the granulite.

The grey gneiss rules in the northern and western parts of the country, from West Norrland down to the province of Calmar. The rock has a prevalent grey colour, and contains as characteristic minerals garnet and in some parts graphite.

The red iron gneiss prevails in western Sweden in the provinces of Vermland, Skaraborg, Elfsborg, and down to the province of Christianstad. The formation is very uniform in its character, the gneiss having a red colour and containing small granules of magnetite, but, nevertheless, not a single iron-mine belongs to this region. The red gneiss contains in many places beds or masses of hyperite.

The granulite, also called eurite and hälleflinta, is the most important of the Pre-Cambrian formation, as it contains all the metalliferous deposits of Sweden. It prevails in the middle part of the country, in the provinces of Vermland, Kopparberg, Vestmanland, and Upsala. It occurs also in some parts of the provinces of Östergötland, Calmar, and Kronoberg. The main rock in this region consists of hälleflinta, a kind of very compact and fine-grained mixture of feldspar, quartz, and mica, often graduating to mica schists, quartzite, and gneiss. With these rocks are often associated limestones, dolomites, and marbles containing serpentine (Kolmården). The metalliferous deposits have generally the form of beds or layers between the strata of granulite and limestones. They are often highly contorted and dislocated.

The iron-mines occur imbedded in more or less fine-grained gneiss or granulite (Gellivaara, Grängesberg, Norberg, Striberg), or separated from the granulite by masses of augitic and amphibolous minerals (*grönskarn*), as in Persberg and Nordmark. Sometimes they are surrounded by hälleflinta and limestone, as at Dannemora, Långban, Pajsberg, and then carry manganiferous minerals. Argentiferous galena occurs at Sala in limestone, surrounded by granulite, and at Guldsmedshytta (province of Örebro) in dark hälleflinta. Copper pyrites occurs at Falun in mica-schists, surrounded by hälleflinta. Zinc blende occurs in large masses at Ammeberg, near the northern end of Lake Vetter. The cobalt ore consists of cobalt-glance (Tunaberg in the province of Södermanland) and of linneite (at Gladhammar, near Vestervik). The nickel ore of Sweden is magnetic pyrites, containing only a very small percentage of nickel. The magnetic pyrites occurs generally imbedded in diorite and greenstones. In the evidently most recent division of the granulite occurs clay-slate (at Grythytta in the province of Örebro).

Large masses of granite are found in many parts of Sweden, and form extensive massiffs as in the provinces of Kronoberg, Örebro, Göteborg, Stockholm, &c. Sometimes the granite graduates into gneiss; sometimes (as north of Stockholm) it encloses large angular pieces of gneiss. In many parts of Sweden occur greenstones, as hyperite, gabbro (anorthite-gabbro at Rådmansö in the province of Stockholm), and diorite, the last often forming beds between the strata of the gneiss.

The Cambrian formation occurs generally associated with the Lower Silurian, and consists of many divisions. The oldest is a sandstone, in which are found traces of worms, impressions of *Medusæ*, and shells of *Lingula*. The upper divisions consist of bituminous limestones, clay-slates, alum-slate, and contain numerous species of trilobites of the genera *Paradoxides*, *Conocoryphe*, *Agnostus*, *Sphærophthalmus*, *Peltura*, &c. In Öland and north of Siljan are found beds with *Obolus*.

The Lower Silurian consists of the following divisions:—(1) beds with *Ceratopyge*; (2) schists with Graptolites; (3) large beds of red and grey limestone (200 feet in thickness) containing *Megalaspis* and *Orthoceratites*. This limestone is largely used as building material; (4) slates with *Trinucleus*; (5) slates with Brachiopods; (6) slates with Graptolites. The Cambrian and Lower Silurian strata occur scattered in several places from Vesterbotten down to Jemtland (around Storsjön), and in the provinces of Skaraborg, Elfsborg, Örebro, Östergötland, and Christianstad. The whole of the island of Öland consists of these strata. The strata are in most places very little disturbed, and form horizontal or slightly inclined layers. They are, south of Lake Vener, capped by thick beds of eruptive diabase (called *trapp*). North of Lake Siljan (province of Kopparberg) occur Lower Silurian but not Cambrian strata, which have been very much dislocated. The Upper Silurian has in Sweden almost the same character as the Wenlock and Ludlow formation of England. The island of Gotland consists entirely of this formation, which occurs also in some parts of the province of Christianstad. In the western part of the province of Kopparberg are extensive deposits of sandstone, separated by beds of diabase, and seemingly of the same age,—the Middle Silurian,—but no fossils have been found in them. In the vicinity of this sandstone region are large beds and massiffs of porphyries. There are still two sets of stratified, not fossiliferous, deposits, viz., in the province of Elfsborg (formation of Dalsland) and around Lake Vetter (formation of Visingsö). The Dalsland formation, which attains the thickness of 6000 to 7000 feet, consists of conglomerates, chlorite schists, quartzites, and mica schists. The Visingsö formation, 800 to 1000 feet in thickness, consists of sandstones, clay-slate, &c. In the western and northern alpine part of Sweden, near the boundaries of Norway, the Silurian strata are covered by crystalline rocks, mica schists, quartzites, &c., of an enormous thickness. These rocks form the mass of the high mountain of Åreskutan, &c.

The Triassic formation (Rhætic division) occurs in the northern

part of the province of Malmöhus. This formation consists partly of sandstones with impressions of plants (cycads, ferns, &c.), and partly of clay-beds with coal.

The Cretaceous formation occurs in the provinces of Malmöhus and Christianstad. Also some spots of this formation are found in the province of Blekinge. The Cretaceous beds of Sweden belong to the most recent division of the Cretaceous formation (chalk and danien). In many parts it has all the characteristics of a coast-deposit.

The most recent deposits of Sweden date from the Glacial and Post-Glacial periods. At the beginning of the Glacial period the height of Scandinavia above the level of the sea was greater than at present, Sweden being then connected with Denmark and Germany and also across the middle of the Baltic with Russia. On the west the North Sea and Cattegat were also dry land. On the elevated parts of this large continent glaciers were formed, which, proceeding downwards to the lower levels, gave origin to large streams and rivers, the abundant deposits of which formed the diluvial sand and the diluvial clay. In most parts of Sweden these deposits were swept away when the ice advanced, but in Skåne they often form still, as in northern Germany, very thick beds. At its maximum the inland ice not only covered Scandinavia but also passed over the present boundaries of Russia and Germany. When the climate became less severe the ice slowly receded, leaving its moraines, called in Sweden *krosstenslera* and *krosstensgrus*. Swedish geologists distinguish between *bottengrus* (bottom-gravel, bottom moraine) and ordinary *krossgrus* (terminal and side moraine). The former generally consists of a hard and compact mass of rounded, scratched, and sometimes polished stones firmly imbedded in a powder of crushed rock. The latter is less compact and contains angular boulders, often of a considerable size, but no powder. Of later origin than the krosstensgrus is the *rullstensgrus* (gravel of rolled stones), which often forms narrow ranges of hills, many miles in length, called *åsar*, running generally, independent of the relief of the country, in a north-and-south direction or towards the south-east. They are of the same nature as the kames and eskers in Ireland and Scotland, and consist of rolled pebbles and sand. It is very probable that these åsar were formed on the bottoms of rivers which cut their way in the inland ice. During the disappearance of the great inland ice large masses of mud and sand were carried by the rivers and deposited in the sea. These deposits, known as glacial sand and glacial clay, cover most parts of Sweden south of the provinces of Kopparberg and Vermland, the more elevated portions of the provinces of Elfsborg and Kronoberg excepted. In the glacial clay shells of *Yoldia arctica* have been met with in many places (*e.g.*, near Stockholm). At this epoch the North Sea and the Baltic were connected along the line of Vener, Vetter, Hjelmar, and Mälar. On the other side the White Sea was connected by Lakes Onega and Ladoga with the Gulf of Finland and the Baltic. In the depths of the Baltic and of Lakes Vener and Vetter there actually exist animals which belong to the arctic fauna and are remnants of the ancient ice-sea. The glacial clay consists generally of their darker and lighter coloured layers, which give it a striped appearance, for which reason it has often been called *hvarfvig lera* (striped clay). The glacial clay of the Silurian regions is generally rich in lime and is thus a marl of great fertility. The deposits of glacial sand and clay are found in the southern part of Sweden at a height ranging from 70 to 150 feet above the level of the sea, but in the interior of the country at a height of 400 feet above the sea.

On the coasts of the ancient ice-sea, in which the glacial clay was deposited, there were heaped up masses of shells which belong to species still extant around Spitzbergen and Greenland. Most renowned among these shell-deposits are the Kapellbackarne near Uddevalla. With the melting of the great ice-sheet the climate became milder, and the southern part of Sweden was covered with shrubs and plants now found only in the northern and alpine parts of the country (*Salix polaris, Dryas octopetala, Betula nana*, &c.). The sea fauna also gradually changed, the arctic species migrating northward and being succeeded by the species existing on the coasts of Sweden. The Post-Glacial period now began. Sands (*mosand*) and clays (*åkerlera* and *fucuslera*) continued to be deposited on the lower parts of the country. They are generally of insignificant thickness. In the shallow lakes and enclosed bays of the sea there began to be formed and still is in course of formation a deposit known by the name *gyttja*, characterized by the diatomaceous shells it contains. Sometimes the gyttja consists mainly of diatoms, and is then called *bergmjöl*. The gyttja of the lakes is generally covered over by peat of a later date. In many of the lakes of Sweden there is still in progress the formation of an iron-ore, called *sjömalm*, ferric hydroxide, deposited in forms resembling peas, coins, &c., and used for the manufacture of iron.[1] (P. T. C.)

[1] The geology of Sweden has been worked out principally by Hisinger, Forselles, Erdmann, Törnebohm, and others. A systematic geological survey of Sweden was set on foot by the Government in 1858. The geology of the fossiliferous strata of Sweden has been elaborated chiefly by Nilsson, Angelin, Linnarsson, Lindström, Nathorst, and others, and that of the Glacial and Post-Glacial periods by Sefström, Von Post, Torell, and others.

Flora.—Of the whole area of Sweden about 132,000 square miles are covered with wild vegetation. This may be broadly divided into five different sorts, viz., the forest, bush, marsh, heath, and prairie vegetations, of which the first-mentioned covers by far the largest area, or upwards of 40 per cent. of the whole surface of Sweden. In the northern part of the country the fir (*Pinus sylvestris*) and the pine (*Pinus Abies*) are the predominating trees; south of Dal Elf the oak (*Quercus pedunculata*), and in the southern and south-western provinces the beech (*Fagus sylvatica*), are, together with the fir and pine, the forest-forming trees. Besides these, there are two species of birch (*Betula verrucosa* and *B. odorata*), which form considerable forests. The bush vegetation derives its character from various species of *Salix*, *Rubus*, and *Rosa*, from *Prunus spinosa* and several other species. The marsh vegetation is composed of some low bushes, of *Cyperaceæ*, *Gramineæ*, and a small number of dicotyledonous and large-flowered monocotyledonous plants. The heath vegetation consists principally of social *Ericaceæ*, especially heather (*Calluna vulgaris*), and the prairie vegetation of a considerable variety of plants.

The Swedish phanerogamic flora is angiospermous, with about thrice as many dicotyledonous as monocotyledonous plants. The gymnosperms are only about 0·25 per cent. of the species of the flora. Its largest families are (in the order of number of species) —*Compositæ*, *Gramineæ*, *Cyperaceæ*, *Cruciferæ*, *Papilionaceæ*, *Rosaceæ*, *Personatæ*, *Ranunculaceæ*, *Umbelliferæ*, *Alsinaceæ*, *Labiatæ*, and *Orchideæ*, the first-named being represented by 160, the last-named by 38 species. The number of families represented amounts to 99. The largest genus of the flora is *Carex*, with 88 species. More than 250 genera are represented by only one species each. The whole number of phaneroganic species now known in Sweden is 1475. Of these only a very small number can be supposed to have originated in the country; the greatest number have immigrated from the south or east after the Glacial period, or have been introduced in one way or another by man. Among the immigrated species about 400 are more or less generally spread over the polar countries of the present period, or are to be found in southern countries as alpine plants. The great mass of these Glacial plants, the earliest inhabitants of the country, are confined to the northern part of Sweden; a smaller number are also to be found, or are only to be found, in the south and in particular localities; a larger number—about 70 species—are abundantly distributed over the whole country.

The Glacial plants were followed and superseded partly by subarctic or subglacial species. Of these the Swedish flora has about 300, of which 50 are abundantly spread over the country, and 80 are pretty generally and abundantly distributed. The principal mass of the remaining species of the flora have immigrated in the same period as the oak, and have spread over the country south of Dal Elf, or also to the provinces immediately to the north of this river; some are outlying steppe-plants; some have entered with the beech, the last immigrated forest-tree of Sweden; and a small number of species, now limited to the west of the country, have possibly entered during a period before that of the beech, when the climate was warmer and moister than at present. (F. K.)

Fauna.—After the close of the Glacial period a twofold immigration of animals occurred,—from the south-west through Denmark, and from the north-east through Finland. Of the existing fauna, many species are widely spread. Especially in the north we find boreal circumpolar forms (wild reindeer, glutton, arctic fox, ptarnigan, several birds of prey, *Grallæ*, and aquatic birds). Others, such as the bear, the wolf, the fox, the magpie, &c., are to be found only in the Old World, but are represented in America by forms resembling them so much as to be regarded by many as only local varieties. Many of the commonest species, *e.g.*, the squirrel, the woodpeckers, the crow, most of the singing-birds, &c., though wanting in the New World, are distributed over Europe and parts of northern Asia.

Besides these we find also specially eastern, southern, and western forms, which have immigrated from widely separated regions. Thus, the northern hare, *Lepus timidus*, properly an inhabitant of Russia and Siberia, but also to be found in the mountainous tracts of central Europe, is common in most parts of Sweden, while the European hare, *Lepus europæus*, which is spread over central and western Europe, and is also to be found in Denmark, is wanting. Most of the field-mice, and many birds which have an exclusively eastern range, have immigrated from Siberia. Among mammals, which nearly all belong to Europe, may be mentioned the roe-deer and the red-deer, the dormouse and the hedgehog; the last-named is common in central and southern Sweden. The elk is considered to have immigrated from the south.

Not very long ago the bear, lynx, and wolf were common in all the forests of northern and central Sweden, but their number has rapidly decreased during the last fifty years. The bear is now confined to the wildest mountain and forest regions of Norrland and Kopparberg län. The wolf was formerly common throughout the country, and between 500 and 600 were killed annually fifty

years ago. Now the number is only 30 to 40, and it is to be found almost exclusively in the mountain regions of Norrland. The lynx is also being exterminated; it is still found in the greater part of northern and central Sweden, at least as far south as Lake Vener. On the other hand, foxes have of late increased, at least in certain parts of the country, and are common everywhere. The glutton also is by no means rare in the mountain regions of Lapland. The destruction of cattle caused by beasts of prey, especially in the north, is not inconsiderable, the loss being estimated at about 2500 reindeer and from 9000 to 10,000 sheep and goats annually.

Not without influence on the number of the smaller beasts of prey are the singular migrations of the mountain LEMMING (*q.v.*), which has its home on the higher mountains above the tree-limit, whence in certain years it migrates in countless numbers to the lower forest regions and lowlands, doing great damage to the vegetation wherever it goes. After the last migration in 1883 the number of the foxes was found to have increased in the regions through which the lemmings had passed.

Of eatable game the elk holds the first place. It has increased in numbers and range of late years, and is pretty common in the forest tracts of central Sweden. The roe-deer, which has its proper home in the southmost parts of Sweden, has also increased of late, and has been seen as far north as Örebro län and Vestmanland. Hares occur in great abundance. Seals are found round the coast; they are hunted chiefly in the Baltic and the Gulf of Bothnia. Besides the larger beasts of prey, martens, weasels, otters, and squirrels are hunted for the sake of their skins, but not to any great extent. The beaver is now probably extinct. Some of the mammals (the bat, hedgehog, dormouse, badger, bear) hibernate; most of the other animals are in winter covered with a thicker coat of hair, and some change their colour to white or grey.

The wood-grouse is the most valued winged game. Its favourite haunt is the great lone forests. Although it has been obliged to retreat before advancing cultivation, it is still pretty common in suitable places. More numerous and almost as much liked is the black grouse, which has somewhat the same distribution as the wood-grouse, but is less particular in the choice of its abode. In the forests of central and especially of northern Sweden the hazel-grouse is numerous in many places, and on the mountains above the tree-limit the ptarmigan is common everywhere. In the birch and willow regions we find the willow-ptarmigan, which above the snow-line is superseded by the common ptarmigan. In winter a great deal of game is exported from Norrland to the southern provinces. The partridge, probably introduced about 1500, with difficulty endures the rude climate of Sweden, and great numbers often perish in winter for want of food. Still it is distributed all over southern and central Sweden as far north as Jemtland, and of late its numbers have increased. The number of woodcock and snipe is, like that of *Grallæ* in general, decreasing. Numerous sea-fowl are found on all the coasts. Some are killed and eaten, but as a rule they are not much relished. Their eggs are collected for food by the inhabitants of the seaboard. The eider-duck is common on both coasts. Among the birds of prey the hawk is the most destructive and the most hunted. The gyrfalcon and the golden eagle are found in Norrland and Lapland, and the sea-eagle throughout the country, especially on the coasts. Some kinds of falcons and owls are very common, the latter especially in northern Sweden. In the interior the most characteristic birds are swallows, sparrows, the birds of the crow family, and the singing-birds, among which the lark, the chaffinch, the thrushes, and the many species of *Sylvia* are most noticeable. The northern nightingale is rare in southern Sweden. The cuckoo is heard everywhere, especially in the forest regions. The mute swan is found in great numbers in a few places in southern and central Sweden. The whooper swan frequents the marshes and lakes of Lapland. The white stork is found in Skåne and Halland, and herons are found in great numbers here and there in Skåne and Blekinge. Cranes are distributed all over the country. Characteristic of the wild forest tracts of Lapland is the Siberian jay. Upwards of 250 species of birds may be considered as belonging to the Swedish fauna, most of them birds of passage, scarcely 40 remaining over winter in their summer resorts. In spring and autumn Sweden is visited by great flocks of the birds of passage of the extreme north, especially geese and snipe.

The reptiles and amphibians are few (3 snakes, 3 lizards, 11 batrachians).

The Swedish rivers and lakes are generally well stocked with fish. The objects of capture are chiefly salmon, eel, pike, different species of perch, burbot, and several species of the *Salmonidæ* and *Cyprinidæ*. The annual income from the fisheries in the lakes and rivers amounts to upwards of £135,800, of which the salmon fisheries alone yield £42,000. Of still greater importance, of course, are the sea-fisheries. In the end of last century the herring fishery in the "skärgård" of the west coast was the most important in Europe, and it is estimated that in one year 1500 millions of herrings were taken. Somewhat later, however, the great shoals disappeared for a long time. In 1877 a new era began in the history of the west-coast fisheries, the take that year being 1,230,000 cubic feet. Since then the herring has returned every year in greater or smaller numbers. There are also captured on the same coast flat-fishes and cod-fish, mackerel, and sprats. The annual produce of the sea-fishery of the south and west coasts is valued at about £111,000. A smaller variety of the herring is found in great abundance on the east coast. In the Sound it is still 11 inches in length, in the Baltic only 6 or 8 inches. This variety is called "strömming," and is the object of an important fishery, annually bringing in more than £175,000. About 140 kinds of fishes are constantly found in Sweden or along its coasts. Of these nearly 100 belong exclusively to the sea, and upwards of 10 are to be found both in salt and fresh water. The remainder are properly freshwater fishes, but many are found in the brackish water of the Baltic coasts. Here we find perch, pike, &c., by the side of purely saltwater fishes, as the "strömming," the flat-fish, &c.

The species of Scandinavian insects number at least 15,000. Notorious among these are the Lapland gnats. The "skärgård" of the west coast has a rich fauna of lower marine animals, partly forms of boreal and arctic descent, partly immigrants from the south. The Royal Academy of Science has here a zoological station, Kristineberg, for the purpose of scientifically examining the marine fauna.

Compared with the fauna of the west coast, that of the Baltic is extremely poor. It consists partly of European boreal forms, which have immigrated from the west, partly of freshwater forms, which have been able to live in the brackish water. But other types also occur, which, though sparingly represented, are of the greatest interest to the naturalist,—namely, certain dwarfed forms,—two or three species of fishes, some crustaceans and other lower marine animals, belonging to a purely arctic fauna, which have immigrated when the Baltic during a part of the Glacial period communicated with the White Sea. They are wanting on the south and west coasts of Sweden, but are found in the Arctic Ocean. Some of them, the four-horned cottus and some crustaceans, are found in Lake Vetter and some other lakes of central Sweden, whither they had come when these lakes formed part of the arctic sea; they have since been shut in and have survived both the climate and the altered composition of the water. The arctic "vikare" seal (*Phoca fœtida*), which is common in the north part of the Baltic but is not found on the west coast, and which is also found in Lake Ladoga, Lake Onega, and some lakes of Finland, is also considered as a survival of the fauna of the Glacial period. On the west coast lobster and oyster fisheries are carried on, the former being very productive. The common mussel is abundant, but in Sweden is only used as bait for fish. The crayfish is common in many places in central and southern Sweden. Pearls are sometimes found in the freshwater mussel *Margaritana margaritifera*, which is met with all over the country. (A. Wi.)

Extent and Population.—Sweden takes rank among the larger countries of Europe. It contains 170,712·60 English square miles, of which area 3,517·29 square miles are occupied by the large lakes Vener, Vetter, Mälar, and Hjelmar, leaving 167,195·31 square miles, distributed among the counties as shown in the following table, which gives the areas and the estimated population in 1885 of the different administrative divisions (the capital Stockholm and the twenty-four "län" or counties) into which the kingdom is divided:— Area and population.

Län.	Square Miles.	Population.
Stockholm (city)	12·65	215,688
Stockholm (rural)	3,008·45	148,841
Upsala	2,052·75	116,406
Södermanland	2,630·64	150,032
Östergötland	4,272·88	267,842
Jönköping	4,440·51	197,392
Kronoberg	3,841·51	166,881
Calmar	4,439·06	240,507
Gotland	1,202·97	52,570
Blekinge	1,164·09	140,071
Christianstad	2,506·97	226,787
Malmöhus	1,847·02	358,178
Halland	1,899·45	136,973
Göteborg (Gothenburg)	1,952·51	281,001
Elfsborg	4,948·15	282,335
Skaraborg	3,283·13	253,467
Vermland	7,345·73	259,958
Örebro	3,502·88	182,513
Vestmanland (Vesterås)	2,623·14	132,056
Kopparberg	11,420·8	194,291
Gefleborg	7,418·70	191,223
Vesternorrland	9,519·92	184,884
Jemtland	19,603·5	93,091
Vesterbotten	21,942·4	113,541
Norrbotten	40,315·5	96,241