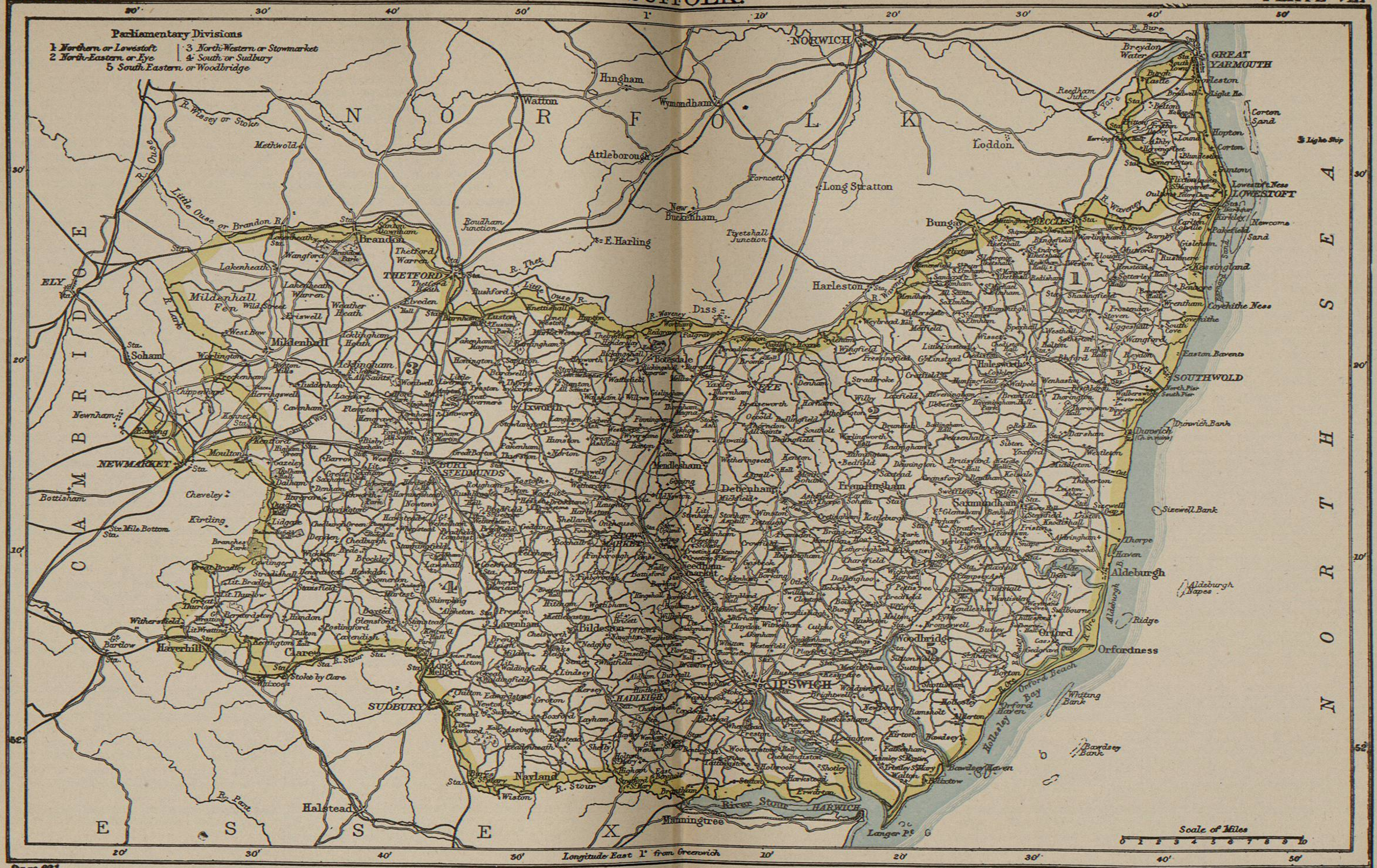

Parliamentary Divisions
1 Northern or Lowestoft
2 North-Eastern or Eye
3 North-Western or Stowmarket
4 South or Sudbury
5 South Eastern or Woodbridge
NORFOLK
CAMBRIDGE
ESSEX
NORTH SEA
NORWICH
GREAT YARMOUTH
LOWESTOFT
SOUTHWOLD
Aldeburgh
Orfordness
Woodbridge
IPSWICH
HARWICH
HADLEIGH
SUDBURY
Clare
Haverhill
NEWMARKET
Mildenhall
Brandon
THETFORD
BURY ST. EDMUNDS
Framlingham
Debenham
Halesworth
Bungay
BECCLES
Harleston
Diss
Eye
Long Stratton
Loddon
Attleborough
Wymondham
Hingham
Watton
E. Harling
Halstead
Manningtree
Nayland
Lavenham
Bildeston
Ixworth
Soham
ELY
Methwold
Longitude East 1° from Greenwich
Scale of Miles

1886, it was determined to widen the existing canal so as to accommodate the increased traffic, and the works are now in progress. Originally constructed by French capital, the Suez Canal has passed more and more into the financial ownership as well as under the political protection of England. In 1875 the British Government purchased 176,602 shares from the khedive of Egypt at the price of £3,976,582, or, including commission and expenses, £4,076,622, and exchequer bonds were issued to the value of £4,000,000. By opening up a passage by which the faunal forms of the Red Sea and of the Mediterranean may respectively advance north and south into regions from which they have hitherto been excluded, the canal has produced some curious results, which have been lately investigated by Dr Conrad Keller of Zurich ("Fauna im Suez-Kanal u. Diffusion de Mediter. u. Eryth. Thierwelt," in *Neue Denkschriften d. allg. schweizer Ges. f. Naturwiss.*, Zurich, 1883). Deep-sea forms are, of course, prevented passing by the shallowness of the canal; and the sandy nature of the soil, the large lakes, the currents, the disturbing influence exerted by the continual movement of vessels, and the excessive saltness of the water all tend to limit and retard the progress of even those forms most adapted to make their way through such a channel. The salinity of the water is much greater than that of the Mediterranean or the Red Sea. This is due mainly to two causes,—the rapid evaporation to which the water in the canal is subjected and the gradual melting of the deposits of salt (the result of previous evaporation in distant ages) in some of the depressions through which the canal is carried. In the Bitter Lakes, for example, it was found in 1872 that on an average each cubic mètre of water contained 156·42 ℔ of salt, or about three times as much as ordinary sea water. A certain number of forms common to the Red Sea and the Mediterranean appear to have migrated from their original homes when in Quaternary times the isthmus was still a lagoon. These being discounted, the following remain as the result of the recent connexion established between the seas: (1) from the Mediterranean *Pholas candida* (as far as Ismailia), *Solen vagina*, *Sphæroma serrata* (to the south of Timsah Lake), *Cardium edule*, *Gammarus* sp. (to the nearer end of the Great Bitter Lake), *Solea vulgaris*, *Umbrina cirrhosa*, *Ascidia intestinalis*, and *Labrax lupus* (to the Red Sea); (2) from the Red Sea seventeen forms were found journeying, but one only, *Mytilus variabilis*, had got out into the Mediterranean proper; *Ostracion cubicus* and *Caranx macrophthalmus* had just got *en route*, and *Prisupoma stridens* (the curious fish that utters a cry when caught), *Mactra olorina*, and *Cerithium scabridum* were found in Lake Menzaleh. This lake seems to prove in the meantime an obstacle to the passage of eight other species.

The following figures are in continuation of the table in vol. iv. p. 792.

Year.	No. of Vessels entering.	Gross Tonnage.	Receipts.	Year.	No. of Vessels entering.	Gross Tonnage.	Receipts.
1875	1494	2,940,708	£1,204,387	1881	2727	5,794,401	£2,050,974
1876	1457	3,072,107	1,229,157	1882	3198	7,122,125	2,421,835
1877	1663	3,418,949	1,339,617	1883	3307	8,051,307	2,633,912
1878	1593	3,291,535	1,272,435	1884	3284	8,319,967	2,495,124
1879	1477	5,236,942	1,214,444	1885	3624	8,985,411	2,488,297
1880	2026	4,344,519	1,629,577	1886	3100	8,183,313	2,309,218

In 1883 10 francs 50 cents were charged per ton (net tonnage), and pilotage dues amounted to 70 cents per ton on an average; on 1st July 1884 pilotage dues were abolished; and in 1885 the transit dues were reduced to 9 francs 50 cents per ton.

Plate VIII. SUFFOLK, the most easterly county in England, is bounded E. by the North Sea, N. by Norfolk, W. by Cambridge, and S. by Essex, the boundaries being chiefly the sea and rivers; it has somewhat the shape of a half moon. Its greatest length north to south from Yarmouth to Landguard Point is about 50 miles, and its average length about 30; its greatest breadth from east to west is about 55 miles. The total area of the county is 944,060 acres, or 1475 square miles.

The principal geological formations are the Chalk and the Tertiaries, but they are frequently overlaid by drift. The surface is for the most part flat or slightly undulating. In the extreme north-west round Mildenhall it joins the fen country. The fen land is bordered by a low range of chalk hills extending from Haverhill by Newmarket and Bury St Edmunds to Thetford. The Chalk extends eastwards, but towards the south passes under the London clay and crag, which adjoins the mouths of the principal rivers and extends from Sudbury by Ipswich to Aldeburgh. The easterly slopes of the Chalk are also overlaid by beds of clay, as well as by post-Glacial gravels, in which flint implements and other indications of the presence of prehistoric man have been found. The most interesting deposits are, however, those of the crag of the late Miocene and Pliocene periods, resting on the London clay, or, where it overlaps, on the Chalk. At the base of the crag resting on the London clay is the famous Suffolk bone bed. The coast-line has a length of about 52 miles, and is comparatively regular, with only slight convexities towards the sea, the bays being generally shallow and the headlands rounded and only slightly prominent. The estuaries of the Deben, Orwell, and Stour are, however, of some length. The shore is generally low and marshy, with occasional clay and sand cliffs. The rivers flowing northwards are the Lark in the north-west corner, which passes in a north-westerly direction to the Great Ouse in Norfolk; the Little Ouse or Brandon, also a tributary of the Great Ouse, flowing by Thetford and Brandon and forming part of the northern boundary of the county; and the Waveney, which rises in Norfolk and forms the boundary between that county and Suffolk, from Palgrave till it falls into the mouth of the Yare at Yarmouth. The Waveney is navigable from Bungay, and by means of Lake Lothing also communicates with Lowestoft. The rivers flowing in a south-easterly direction to the North Sea are the Blyth; the Alde or Ore, which has a course for a long distance parallel to the seashore, and has its port at Orford; the Deben, from Debenham, flowing past Woodbridge, up to which it is navigable; the Orwell or Gipping, which is navigable to Stowmarket, whence it flows past Needham Market and Ipswich; and the Stour, which forms nearly the whole southern boundary of the county, receiving the Brett, which flows past Lavenham and Hadleigh; it is navigable from Sudbury and has an important port at Harwich. The county has no valuable minerals. Cement is dug for Roman cement; and lime and whiting are obtained in various districts.

Agriculture.—Suffolk is one of the most fertile counties in England. In the 18th century it was famed for its dairy products. The high prices of corn during the wars of the French Revolution led to the extensive breaking up of its pastures, and it is now one of the principal corn-growing counties in England. There is considerable variety of soils, and consequently in modes of farming, in different parts of the county. Along the sea-coast a sandy loam or thin sandy soil prevails, covered in some places with heath, on which large quantities of sheep are fed, and interspersed with tracts, more or less marshy, on which cattle are grazed. The best land adjoins the rivers, and consists of a rich sandy loam, with patches of lighter and easier soil. In the south-west and the centre is much fine corn land, having mostly a clay subsoil, but not so tenacious as the clay in Essex. In climate Suffolk is one of the driest of the English counties, the rainfall being only half that of the counties in the west. Towards the north-west the soil is generally poor, consisting partly of sand on chalk and partly of peat and open heath.

According to the agricultural returns for 1886, 780,448 acres or nearly five-sixths of the total area were under cultivation, 363,641 being under corn crops, 120,256 under green crops, 94,893 clover and rotation grasses, 174,970 permanent pasture, 19 flax, 57 hops, and 26,612 fallow. Wheat and barley are the most important of the corn crops, having an area of 118,873 and 151,630 respectively. Of green crops only 2452 were under potatoes, while 55,434 were under turnips and swedes, 36,211 under mangold, 852 under carrots, 4100 under cabbage, and 21,207 under vetches,—figures which indicate that much attention is paid to the winter feeding of cattle. Horses in 1886 numbered 42,617, of which 32,262 were used solely for purposes of agriculture. The breed known as Suffolk punches is one of the most valued for agricultural purposes in England (see AGRICULTURE, vol. i. p. 385). Cattle numbered 70,695, of which 23,652 were cows and heifers in milk or in calf, and 17,322 other cattle two years old and above. The breed native to the county is a polled variety, on the improvement of which great pains have been bestowed in recent years. The old Suffolk cows, famous for their great milking qualities, were of various colours, yellow predominating. The improved are all red. Much milk is now sent to London, Yarmouth, &c. Many cattle, mostly imported from Ireland, are grazed in the winter. The sheep are nearly all of the black-faced improved Suffolk breed, a cross between the old Norfolk horned sheep and Southdowns. Sheep numbered 433,986, of which 230,954 were one year old and above. Suffolk is famous for pigs. The breed most common is small and very compact, and black in colour. Pigs numbered 121,866 in 1886.

The following table gives classifications of holdings in 1875 and 1885:—

Years.	50 acres and under.		From 50 to 100 acres.		From 100 to 300 acres.		From 300 to 500 acres.		From 500 to 1000 acres.		Above 1000 acres.	
	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.	No.	Area.
1875	5667	66,251	1436	101,644	2043	336,383	387	137,894	169	110,169	12	14,744
1885	5607	64,899	1278	94,994	1872	330,133	409	154,590	174	115,089	17	22,314

Thus in 1875 there were in all 9714 holdings with 767,085 acres, and in 1885 9357 with 782,019 acres. According to the latest landowners *Return* (1873) Suffolk was divided among 19,276 proprietors, holding 920,268 acres, at a valued rental of £1,784,827, or an average all over of about £1, 18s. 9½d. per acre. Of the owners 12,511 or nearly three-fourths possessed less than one acre each. The following possessed over 10,000 acres each:—Lord Rendlesham, 19,869; George Tomline, 18,473; marquis of Bristol, 16,954; the maharajah Dhuleep H. H. Singh, 14,615; Lord Huntingfield, 11,713; earl of Stradbroke, 11,697; Sir Richard Wallace, 11,223; Lord Henniker, 10,910.

Communication.—The river navigation affords means of communication with different ports, and supplies facilities for a considerable amount of traffic. The county is intersected in all directions by branches of the Great Eastern Railway, which touch at almost every town of importance.

Manufactures and Trade.—The county is essentially agricultural, and the most important manufactures relate to this branch of industry. They include that of agricultural implements, especially at Ipswich, Bury St Edmunds, and Stowmarket, and that of artificial manures at Ipswich and Stowmarket, for which coprolites are dug. Malting is extensively carried on throughout the county. There is a gun-cotton manufactory at Stowmarket, and gun flints are still made at Brandon. At different towns a variety of small miscellaneous manufactures are carried on, including silk, cotton, linen, woollen, and horsehair and cocoa-nut matting. The principal ports are Yarmouth (situated chiefly in Norfolk), Lowestoft, Southwold, Aldeburgh, Woodbridge, and Ipswich. Yarmouth is one of the most important fishing stations on the east coast of England; within the county Lowestoft is the chief fishing town. Herrings and mackerel are the fish most abundant on the coasts.

Administration and Population.—Suffolk comprises 21 hundreds; the boroughs of Beccles (pop. 5721), which has several large maltings; Bury St Edmunds (16,111), the chief town in West Suffolk; Eye (2296), an ancient market town; Ipswich (50,546), the largest town and principal port of the county; Aldeburgh (2106), the birth-place of Crabbe; Southwold (2107), a fishing town and bathing resort; the largest part (5855) of Sudbury (6584), a market and manufacturing town; and small portions of the boroughs of Thetford and Great Yarmouth, which are situated chiefly in Norfolk. The other principal towns are Hadleigh (3237), with a considerable trade in corn and malt; Haverhill (3685) (partly in Essex), of great antiquity, and possessing important silk manufactures; Lowestoft (16,755), a port and fishing station; Stowmarket (4052); and Woodbridge (4544), with some coasting trade. Suffolk is divided into geldable portions, in which the sovereign has the chief rights, and liberties. The liberties are those of St Etheldreda, St Edmund, and the dukedom of Norfolk. The court of quarter sessions is at Ipswich for the eastern division and by adjournment at Bury St Edmunds for the western. There are nineteen petty and sessional divisions. The hundreds of Hartismere and Stow and the borough of Eye are for petty sessional purposes included in the eastern division, and for other purposes in the western. The boroughs of Bury St Edmunds, Ipswich, Great Yarmouth, and Sudbury have commissions of the peace and separate courts of quarter sessions; and Eye and Southwold have commissions of the peace. For parliamentary purposes the county was until 1885 divided into East and West Suffolk, but it now constitutes five divisions, each returning one member, viz., North or Lowestoft division, North-east or Eye, North-west or Stowmarket, South or Sudbury, and South-east or Woodbridge. Bury St Edmunds returns one member and Ipswich two; Eye, which formerly returned one member, was merged in the North-east division of the county in 1885. The county contains 517 civil parishes with parts of 7 others. It is mostly in the diocese of Norwich. From 214,404 in 1801 the population had increased by 1821 to 271,541, by 1841 to 315,073, by 1861 to 337,070, and by 1881 to 356,893, of whom 174,606 were males and 182,287 females. The number of persons to an acre was 0·38 and of acres to a person 2·65.

History and Antiquities.—The district which now includes Norfolk, Suffolk, and a portion of Cambridge, and afterwards formed East Anglia, had in early times, on account of the marshes to the west, practically the character of a peninsula. It was inhabited by the Iceni, who had their capital at Icklingham, in the north-west of Suffolk. Of the numerous barrows and tumuli belonging to this period mention may be made of those at Fornham St Geneveve and those between Aldeburgh and Snape. Many of the mediæval castles were built on ancient mounds. The district submitted to the Romans during the campaign of Aulus Plautius, and, although the Iceni joined the Trinobantes under Boadicea, the resistance made was ultimately fruitless. A Roman road from London crossed the centre of Suffolk northwards by Stratford St Mary, Needham Market, and Billingford (Norfolk) to Norwich, another passing in a more westerly direction to Thetford. Walton, where important Roman relics have been found, Dunwich (possibly *Sitomagus*), and Burgh Castle (probably *Combretonium*), one of the most perfect specimens of a Roman fort in England, enclosing an area of five acres, are supposed to have been Roman fortified stations erected for the defence of the Saxon shore. Other Roman stations were at Stratford St Mary, Thetford, and Icklingham. The capital of the kingdom of East Anglia was at Dunwich in Suffolk. Afterwards East Anglia was divided into Norfolk and Suffolk. Sigebert established an ecclesiastical diocese at Dunwich in 630, and erected a palace and a church partly out of the Roman remains. The earldom of Norfolk and Suffolk was bestowed by the Conqueror on Ralph le Guader. Though Suffolk suffered from incursions of the Danes, they did not effect a complete subjugation of it. The prevailing terminations of the place names are Anglian. The remains of old castles are comparatively unimportant, the principal being the entrenchments and part of the walls of Bungay, the ancient stronghold of the Bigods; the picturesque ruins of Mettingham, built by John de Norwich in the reign of Edward III.; Wingfield, surrounded by a deep moat, with the turret walls and the drawbridge still existing; the splendid ruin of Framlingham, with high and massive walls, originally founded in the 6th century, but restored in the 12th; the outlines of the extensive fortress of Clare Castle, anciently the baronial residence of the earls of Clare; and the fine Norman keep of Orford Castle, on an eminence overlooking the sea. Among the many fine residences within the county there are several interesting examples of domestic architecture of the reigns of Henry VIII. and Elizabeth. Throughout its whole history the annals of Suffolk have been comparatively uneventful. It adhered with Norfolk to the cause of the Parliament. James duke of York twice defeated the Dutch off the coast,—viz., Van Tromp off Lowestoft on 3d June 1665 and De Ruyter in Southwold Bay on 28th May 1672. Of monastic remains the most important are those of the great Benedictine abbey of Bury St Edmunds, noticed under that town; the college of Clare, originally a cell to the abbey of Bec in Normandy and afterwards to St Peter's, Westminster, converted into a college of secular canons in the reign of Henry VI., and still retaining much of its ancient architecture, and now used as a boarding-school; the decorated gateway of the Augustinian priory of Butley; and the remains of the Grey Friars monastery at Dunwich. A peculiarity of the church architecture is the use of flint for purposes of ornamentation, often of a very elaborate kind, especially on the porches and parapets of the towers. Another characteristic is the round towers, which are confined to East Anglia, but are considerably more numerous in Norfolk than in Suffolk, the principal being those of Little Saxham and Herringfleet, both good examples of Norman. It is questionable whether there are any remains of Saxon architecture in the county. The Decorated is well represented, but by far the greater proportion of the churches are Perpendicular, special features being the open roofs and woodwork and the fine fonts.

See Blome's *Description of Suffolk*, 1673; Kirby's *Description*, 1748, 2d ed. 1829; Suckling's *History of Suffolk*, 1846-48; Hervey's *Visitation of Suffolk in 1561*, ed., with additions, by Dr J. J. Howard, 1866; and Browne's *History of Congregationalism and Memorial of Churches in Suffolk*, 1877. (T. F. H.)

SUFISM. See MOHAMMEDANISM, vol. xvi. p. 594; MYSTICISM, vol. xvii. p. 130; and SUNNITES, p. 659 *sq. infra*.

SUGAR. Formerly chemists called everything a "sugar" which had a sweet taste, and acetate of lead to this day is known as "sugar of lead" in commerce and familiar chemical parlance; but the term in its scientific sense soon came to be restricted to the sweet principles in vegetable and animal juices. Only one of these—cane sugar—was known as a pure substance until 1619, when Fabrizio Bartoletti isolated the sugar of milk and proved its individuality. In regard to all other "sugars" besides these two the knowledge of chemists was in the highest degree indefinite, and remained so until about the middle of the 18th century, when Marggraf made the important discovery that the sugars of the juices of beet, carrots, and certain other fleshy roots are identical with one another and with the sugar of the cane. Lowitz subsequently showed that the granular part of honey is something different from cane sugar; this was confirmed by Proust, who found also

that Lowitz's honey sugar is identical with a crystallizable sugar present largely in the juice of the grape. Proust's investigations extended to other sweet vegetable juices also. All those investigated by him owed their sweetness to one or more of only three species,—(1) cane sugar, (2) grape sugar, (3) (amorphous) fruit sugar. Proust's results obtain substantially to this day; a number of new sugars strictly similar to these three have been discovered since, but none are at all widely diffused throughout the organic kingdom.

The quantitative elementary composition of cane sugar was determined early in the 19th century by Gay-Lussac and Thénard, who may be said to have virtually established our present formula, $C_{12}H_{22}O_{11}$. Under FERMENTATION (vol. ix. p. 93) it has been explained how Gay-Lussac (in 1811) came to mis-correct his numbers so as to bring them into accordance with what we now express by $C_6H_{12}O_6 = \frac{1}{2}C_{12}H_{24}O_{12}$. Dumas and Boullay, some years later, found that cane sugar is what Gay-Lussac and Thénard's analysis makes it out to be, while the "corrected" numbers happen to be correct for grape sugar. Dumas and Boullay's research completed the foundations of our present science of the subject. "Sugar" is now a collective term for two chemical genera named *saccharoses* (all $C_{12}H_{22}O_{11}$) and *glucoses* (all $C_6H_{12}O_6$). All sugars are colourless non-volatile solids, soluble in water and also (though less largely) in aqueous alcohol; from either solvent they can in general be obtained in the form of crystals. The aqueous solution exhibits a sweet taste, which, however, is only very feebly developed in certain species.

All sugars and their solutions have the power of turning the plane of polarization of light. In a given solution of a given kind of sugar the angle α through which the plane is turned is governed by the equation $\alpha = \pm[\alpha]lp$, where l stands for the length of solution traversed (the customary unit of length being the centimetre) and p for the number of grams of dry sugar present in a volume of solution equal to that of (say) 100 grams (3·52 oz.) of water, where, however, "gram" must be taken as merely a convenient word for "unit of weight"; $\pm[\alpha]$, *i.e.*, the special value of α for $l=1$ and $p=1$, is called the specific rotatory power of the sugar operated upon. The sign $\pm$ indicates that the plane of polarization is turned either to the right or to the left according to the nature of the species. For a given species and a given temperature $[\alpha]$ has a constant value. Supposing its value to have been determined by standard experiments and l to be known (or to be kept constant throughout and taken as unit of length), the determination of α for a given solution suffices for the calculation of p. This method is largely used industrially for the assaying of cane sugar.

Sugars, though neutral to litmus and inert towards such substances as carbonates on the one hand and aqueous acids (*quâ* acids) on the other, combine with strong bases, such as caustic potash, baryta, and lime, into *saccharates*, and, when brought into contact with the strongest nitric acid (or a mixture of the same with oil of vitriol) or (at the proper temperature) with acetic anhydride, unite with these into nitrates and acetates respectively, with elimination of water. These nitrates, &c., are related to the respective sugar exactly as (to take an analogous case) nitrate of methyl, $CH_3(NO_3)$, is to methyl-alcohol, $CH_3(OH)$; only in the case of a sugar a plural of NO_3's is capable of entering into every one molecule and turning out so many HO's; hence sugars are said to be *polyvalent alcohols*. Of the several points of difference between saccharoses and glucoses the most important is that, while the latter remain unchanged when boiled with highly dilute sulphuric or hydrochloric (or certain other kinds of) acid, the former take up water and every molecule breaks up into two molecules of glucose, which in general are of different kinds. Cane sugar, for instance, yields *dextrose* and *lævulose* (so called from the direction in which they turn the plane of polarized light), thus—

$$\underset{\text{Cane Sugar}}{C_{12}H_{22}O_{11}} + H_2O = \underset{\text{Dextrose}}{C_6H_{12}O_6} + \underset{\text{Lævulose.}}{C_6H_{12}O_6}$$

Cane sugar turns the plane of polarized light to the right; the mixed glucose produced is lævo-rotatory; hence the process is spoken of technically as involving the *inversion* of cane sugar, and the mixed product is called *invert sugar*. The term "inversion," however, has come somehow to be used for all decompositions which fall under the above equation; occasionally it is used even in a wider sense, to include any decomposition of a carbo-hydrate (*e.g.*, starch) into two less complex carbo-hydrates.

All sugars are liable to fermentative changes; a special character of the three principal vegetable sugars is that, when brought into contact as solutions with yeast (living cells of saccharomyces), under suitable conditions, they suffer vinous fermentation, *i.e.*, break up substantially into carbonic acid and alcohol. Dextrose and lævulose break up directly,—$C_6H_{12}O_6 = 2C_2H_6O + 2CO_2$. Cane sugar first, under the influence of a soluble ferment in the yeast, gets inverted, and the invert sugar then ferments, the dextrose disappearing at a greater rate than the lævulose.

It is remarkable that no sugar has ever been produced artificially even in the sense of being built up from other native organic substances of less chemical complexity. It is easy to produce dextrose from starch, or lævulose from inulin, or both from cane sugar, by inversion; but none of these processes is reversible by known methods. Yet the problem of producing cane sugar artificially may in a sense be said to have found a virtual solution at the hands of a German-American chemist, Fahlberg.[1] Fahlberg by subjecting toluene, $C_6H_5CH_3$ (one of the components of coal-tar naphtha), to a series of operations has produced from it a body, $C_6H_4\genfrac{}{}{0pt}{}{CO}{SO}NH$, which he called *saccharine*, because he found it to be about 230 times as sweet as cane sugar. This saccharine is a white crystallized solid, only slightly soluble in cold water, but sufficiently so to admit of its incorporation with jellies, puddings, beverages, &c. A mixture of one part of it with 1000 parts of ordinary grape sugar (as produced industrially from starch) is as sweet as the best cane sugar. The substance, though an antiseptic, is said to be perfectly innocuous.

Glucoses.

Of these a pretty large number are now known, but only lævulose and dextrose need be noticed here. Both are largely present in all kinds of sweet fruit juices and in honey. In most of these materials they are accompanied by a small proportion of cane sugar, which forcibly suggests that the glucose in fruit juices is really inverted cane sugar. But, in opposition to this surmise, the proportion of cane sugar in oranges increases during the process of ripening, and the sourest of all fruits—the lemon—contains four parts of cane for every ten of invert sugar; besides, the juices of grapes and sweet cherries contain no cane sugar whatever. According to Stammer, the young leaves of the sugar cane contain abundance of invert sugar, which gradually disappears and gives way to cane sugar as the leaves develop and ultimately dry up. In the living body of man dextrose is constantly being produced from the glycogen of the liver, to be taken up by the blood and oxidized into carbonic acid and water. In certain diseases, however (see NUTRITION, vol. xvii. p. 681), the sugar survives and passes into the urine; as much as one pound avoirdupois may be discharged by a diabetic patient in twenty-four hours. A numerous class of vegetable substances, known as *glucosides*, contain glucose of some kind in the sense that, when decomposed by boiling dilute sulphuric acid or by the action of certain ferments, they split up into glucose and some product—not a sugar—which is characteristic of the respective species. For examples, see FERMENTATION, vol. ix. p. 96.

Dextrose is being produced industrially from starch by inversion (see below), and sold as grape sugar. Such grape sugar, however, is very impure. For the preparation of pure dextrose rich diabetic urine, honey, and cane sugar are convenient materials. The method recommended by Soxhlet is to dissolve 160 grams (5·64 oz.) of powdered cane sugar in a mixture of 500 c.c. of alcohol of 85 per cent. by weight and 20 c.c. of fuming hydrochloric acid at 45° C. and to allow the solution to stand. After about a week dextrose begins to crystallize out, and, if the mixture is being frequently agitated, the deposit of crystals increases gradually. A small crop of crystals thus obtained suffices for inducing crystallization in a large supply of fresh liquor. Dextrose crystallizes from its highly concentrated aqueous solution—somewhat tardily—in minute soft crystals, united into warts or cauliflower-like masses, which contain $1H_2O$ of crystal water beside $C_6H_{12}O_6$. The crystals lose their water at 100° C. From absolute alcohol it crystallizes as $C_6H_{12}O_6$. It dissolves in 1·2 parts of cold and far less of boiling water. 100 parts of alcohol of 0·837 specific gravity dissolve 1·94 parts at 17°·5 C. and 21·7 parts on boiling. In a given volume of aqueous solu-

[1] See *Amer. Chem. Jour.*, i. p. 170, ii. p. 181, and i. p. 425; short notices in *Jour. Soc. Chem. Ind.*, iv. p. 608, and February 1886.