Salt and other condiments / by J. J. Manley.

INTERNATIONAL HEALTH EXHIBITION

HANDBOOKS

ISSUED BY AUTHORITY.

SALT,

AND OTHER CONDIMENTS.

BY J. J. MANLEY, M.A.,

Author of 'Notes on Fish and Fishing,' 'The Literature of Sea and River Fishing,' etc., etc., etc.

SAL SAPIT OMNIA.

"For many things are swallowed by animals, rather for *condiment*, gust or medicament, than any substantial nutriment."—BROWN, *Vulgar Errours*, b. iii. c. 22.

PRINTED AND PUBLISHED FOR THE

Executive Council of the International Health Exhibition, and for the Council of the Society of Arts,

BY

WILLIAM CLOWES & SONS, LIMITED,

INTERNATIONAL HEALTH EXHIBITION,

AND 13, CHARING CROSS, S.W.

1884.

ONE SHILLING

International Health Exhibition,

LONDON, 1884.

SALT

AND

OTHER CONDIMENTS.

BY

J. J. MANLEY, M.A.

AUTHOR OF 'NOTES ON FISH AND FISHING,' 'THE LITERATURE OF SEA AND RIVER FISHING' ETC., ETC., ETC.

SAL SAPIT OMNIA.

"For many things are swallowed by animals, rather for *condiment*, gust or medicament, than any substantial nutriment."—BROWN, *Vulgar Errours*, b. iii. c. 22.

PRINTED AND PUBLISHED FOR THE

Executive Council of the International Health Exhibition,

and for the Council of the Society of Arts,

BY

WILLIAM CLOWES AND SONS, LIMITED,

INTERNATIONAL HEALTH EXHIBITION,

AND 13, CHARING CROSS, S.W.

1884.

LONDON:
PRINTED BY WILLIAM CLOWES AND SONS, LIMITED
STAMFORD STREET AND CHARING CROSS.

CONTENTS.

PART I.

CHAPTER I.

PAGE

CONDIMENTS IN GENERAL—SALT IN PARTICULAR . . . 1

CHAPTER II.

THE SALT SUPPLY OF THE WORLD 18

CHAPTER III.

ROCK-SALT AND BRINE IN THE ENGLISH SALT DISTRICTS . 32

CHAPTER IV.

THE MANUFACTURE OF WHITE SALT FROM BRINE . . 41

CHAPTER V.

ANALYSES :—SEA WATER—SEA SALT—BRINE—WHITE SALT —ROCK SALT 47

CHAPTER VI.

THE SALT TRADE :—STATISTICS OF PRODUCTION IN GREAT BRITAIN—EXPORTS—MANUFACTURERS—PANS—COST OF PRODUCTION—PRICES—PROFITS—PROSPECTS OF TRADE —HEALTH AND WAGES OF OPERATIVES 61

CHAPTER VII.

LANDSLIPS AND SUBSIDENCES OF THE SOIL IN THE SALT DISTRICTS OF CHESHIRE AND WORCESTERSHIRE . . 77

CHAPTER VIII.

SALT-LORE 86

PART II.

CHAPTER IX.

PAGE
MUSTARD 100

CHAPTER X.

PEPPER 112

CHAPTER XI.

VINEGAR 120

CHAPTER XII.

SAUCES—PICKLES—CURRIES—SPICES 128

INTRODUCTION.

IF readers, judging from its title, "Salt and other Condiments," expect to find this Handbook a treatise on the condiments of all nations, or even on all those used by ourselves, they will be disappointed. Limitation of space utterly precludes the idea of a comprehensive survey of so wide a subject.

And further, as salt is the condiment, not only most acceptable to the taste, and as generally believed most necessary and healthful to the body, but the one most universally used throughout the world, and as its large consumption at home, and exportation abroad have led to its becoming one of our most important industries, the greater portion of the space so limited is naturally taken up with its history, and especially with its production and manufacture in this country.

As regards "other condiments," the writer had at the outset considerable difficulty in determining in his own mind what the term "condiment" should include, or what it included in the minds of those who assigned him the present task. The Latin verb *condio*, being derived from *con*, i.e. *cum*, "together," and *duo* the ancient form of *do*, to "give," perhaps originally and strictly, when applied to gustatory matters, signified to "compound" or "concoct" something to give seasoning or flavouring. Every schoolboy has read of the "*male conditum jus*" of Horace—"the badly concocted sauce,"—which a young aspirant for the birch translated as the "badly established law." Hence *condimentum* would strictly mean some "compound" in the way of a sauce or seasoning, composed of various

ingredients, but making a homogeneous whole. But as *condio* has the further meaning of preserving and pickling substances, and generally of making food savoury, *condimentum* came to include every kind of article, liquid or solid, simple or compound, which, not being primarily food itself, was used to flavour and season food. In like manner our word "condiment" has its more restricted and its more general application; signifying in the first place the "compounds" of which sauces, curries, chutnees, etc., would be the representatives, and in the second place, all substances used as "food accessories" for the purpose of stimulating and pleasing the palate. In this latter sense it would cover the large family of "spices," oil, olives, capers, salad plants including onions and their congeners, mushrooms, truffles, and even sweets, such as sugar, honey, and preserved fruits; and last, but not least, the mineral, salt. All these and many more have been classed as "condiments" by various writers and compilers of works of reference; but such a field as this cannot possibly be traversed here; and we must confine our attention almost entirely to those common condiments which are to be found on every table, viz., salt, and the occupants of the humble cruet stand, mustard, pepper, and vinegar.

And this can be done on something like an intelligible principle, because the condiments just mentioned are those specially and almost exclusively used without combination with any others, and directly by the eater, who applies them first hand to the food before him. The great majority of other condiments, using the word in a comprehensive sense, are mainly employed directly by the cook and only indirectly or second hand by the eater. This principle of selection is not of course quite accurate, as, strictly speaking, sauces and pickles, and some other "food accessories," would come within the same category as the four common condiments of ordinary cruet stands; but it may be taken as indicating the main scope of this handbook.

Referring again for a moment to salt, though the writer

has visited the salt districts on a "voyage of discovery," and found very much to engage his attention there, the subject of salt production and manufacture does not give much scope for original writing, or for very interesting descriptions ; the matter in hand being rather one in the elucidation of which statistics of production, details of manufacturing processes, and analyses of substances must necessarily occupy considerable space. At the same time the writer has endeavoured to make this a " popular " handbook, so that general readers may without difficulty gain a fair knowledge of the history of the great " popular " condiment ; while those of a more scientific or practical turn may have something in the way of a reliable though small volume of reference.

In endeavouring to carry out this twofold object he is much indebted to many standard works of reference, such as Spon's invaluable *Encyclopædia of the Industrial Arts, Manufactures and Commercial Products;* and personally to the Secretary of the " Salt Chamber of Commerce," to the Managers of Mr. John Corbett's Salt Works at Stoke Prior, of the "Droitwich Salt Company," and of the "Maldon Crystal Salt Company," and further to Messrs. Bumsted, of King William Street, and other gentlemen connected with the salt trade. He only regrets that he has been unable for want of space to use more of the interesting information which they so kindly gave him.

SALT AND OTHER CONDIMENTS.

PART I.

CHAPTER I.

CONDIMENTS IN GENERAL—SALT IN PARTICULAR.

It has been noted in the Introduction to this Handbook that it is difficult to define the exact meaning of the word "condiment," and that authorities differ somewhat as to the character and number of articles which the term should cover, some using it in a comprehensive, and others in a more restricted sense. For the purpose of the earlier part of this chapter let us take it in its wider meaning as signifying any substances used for the "flavouring" of food, and not as food itself.

Logicians have defined man as "an animal that cooks its food;" and it has generally been held that this "difference" of cooking distinguishes him fairly and logically from all other animals. But does it? Yes—at the present period of his existence: but did he always cook his food? It may be open to doubt whether he did so. If we take the Bible record (Gen. i. 29–30) we find something more than a suggestion that man in the earlier period of his existence was a vegetarian. Moreover, the formal commission to man to use the vegetable world for food was given to all other animals, and therefore probably he would not need to cook his food any more than they would. In the further commission to man after the flood (Gen. ix. 3.) "every moving thing that hath life" was given him as "meat," and allusion is made to the "green herb" given him before. Now if man was only a vegetarian before the flood, and did not cook his

vegetable food, the question may be asked whether he used condiments of any kind with it. A large or at least a certain portion of his vegetable food would necessarily be somewhat insipid, and he would almost naturally seek for something wherewith to flavour it. Salt in some form or other would soon have presented and recommended itself to him; and it would not be long before he would have discovered some vegetable productions, and especially the seeds of some herbs agreeable in flavour but too strong and pungent to eat alone or in large quantities; and thus we may suppose he would have been led to use them as "condiments." And indeed we may go further and hold that he had a natural instinct for condiments from the very beginning, if we judge from the fact that man in all ages and in all countries, as far as we can gather from history, had this instinct, and even craving.

If this be so, let us ask whether a more logical definition of man than that before mentioned would not be "an animal that uses condiments with its food"? Of course it might be answered that we do know for certain that he did so use condiments from the beginning; and it might be argued that he has only developed a taste for them, as he has for various forms of narcotics and alcohol, as his life has gradually become more artificial. Still we are confronted with the fact that there are races of human beings still living primitive, unartificial, and uncivilised lives, which have all these tastes, and indulge them in some way or other, and further so strongly develop them when opportunities are given them as to suggest that they are natural instincts. But however this may be, we find different races of men in different parts of the world which have long selected and largely used certain condiments with their ordinary food. And this selection it must be noted has not been based on any chemical knowledge, but apparently on some natural instinct. To take one instance out of many, it is, to say the least of it, strange at first sight that different races, dwelling remote from one another have fixed on vegetable productions so unlike to each other as the onion and garlic, the

assafœtida plants, and the mustards—all belonging to different botanical orders—as condiments. The simple explanation is that these vegetables contain compounds of sulphur and allyl; and, as in the case of certain beverages and narcotics, men seem to have been led to this selection by a kind of human instinct, guiding them blindly, as it were to plants, which were capable of yielding to the body the same or similar compounds. Future research may probably show that these compounds of allyl exercise a peculiar physiological action upon the system, by which certain of its natural cravings are allayed, and its general comfort promoted. This is rendered more probable by the remarkable circumstance that the many kinds of mustard, the use of which as condiments so extensively prevails, owe their peculiar properties to the presence of compounds of the same substance—allyl.

It seems then reasonable to suppose that a taste and even craving for condiments is a human instinct; but it may be further asked whether this taste is not instinctive in other animals than man, or at least in some of them. If it be so, then the suggested definition of man as "an animal that uses condiments with its food," is logically untenable. It is a curious and interesting question as to what extent animals take certain substances, not as a food but as a relish with food, and as of acceptable and pleasant flavour, enjoyed without any actual sense of satisfying hunger, much in the same way as a child enjoys a sweetmeat. But we can hardly pursue it here. Suffice it to say that there is evidence that animals other than man appreciate condiments, and, certain it is, that most quadrupeds and several birds have a special love of salt. Brown in his *Vulgar Errours* (III. 22.) says, "For many things are swallowed by animals rather for *condiment* gust, or medicament, than any substantial nutriment." Horses, cats, dogs, and many other animals are attracted by substances flavoured and scented with condiments (using the term in still more extended sense), and however absurd may be the recipes for medicated baits given by Izaak Walton and

other angling writers of past generations, still it is a fact that "condited" pastes have special attractions for some kind of fish.

Ancient nations of the East, and the Greeks and Romans after them, in the luxurious periods of their histories were much given to the use of all kinds of condiments, both in their simple and more complicated forms: and as commerce brought them within reach, the people of this country came freely to use both the more highly and more delicately flavoured contributions from foreign climes in addition to their own natural productions, which in many instances were the wild growths of the fields, hedges, and woods. We may not be able to agree with the old Doctors of Gastronomy, and authors of recipes who recommended our forefathers to eat ginger with lamb; cinnamon with thrushes; mustard with mutton, salmon, pheasants, partridges, and rabbits; vinegar with roast beef and goose; and a combination of sugar and salt with divers birds: but we must not argue the question, as it would be at once said that all such combinations are mere matters of taste, and that every one has a right to "condite" for himself, as, for instance, the Russian does when he takes currant jelly with red herrings and kippers. Quite so: but at the same time we may reserve to ourselves the right to hold the opinion that there are tastes and tastes, and that some of them would be all the better for a little education. Our country boors, destined to be soon enfranchised, prefer the adulterated beer from the "Black Bull" to a bottle of Château Yquem; a rasher of musty bacon to a cut from a prime haunch of buck venison in full season and well hung; and the blue, red, and yellow daubs of scriptural personages and incidents to Murillo's Holy Family in the National Gallery. Of course this is all a matter of taste; but as "sweetness and light" extend with the franchise, and Schools of Art and Schools of Cookery make their influence felt even in remote villages, "tastes" will gradually change. But speaking more seriously we must hold that there are certain proprieties to be observed

in the use of condiments, and that in this matter the axioms of the "Physiologie du Gôut" cannot be violated without the transgressor writing himself down as devoid of "taste."

Although there once existed among "the faculty" a certain amount of prejudice against the use of our ordinary condiments with the exception of salt, there now seems to be a general consensus of dietists in their favour. Being adjuncts to and accessories of food, rather than food itself, condiments are generally speaking of great value in rendering the substances we eat more palatable, and in stimulating jaded appetites. They are stimulants of the digestive organs, promoting the flow of saliva, the gastric juice, and other internal secretions, and thus they directly aid the process of digestion. Their use and value is thus summed up by Dr. Pavy in his standard *Treatise on Food and Dietetics.* He says "Condiments consist of seasoning or flavouring agents. Without being strictly alimentary substances, they nevertheless play no insignificant part in the alimentation of man, and prove of service in more ways than one. Their first effect is to render food more tempting to the palate, and thereby increase the amount consumed. We are guided in the choice of food by taste and smell, and that which agreeably affects these senses excites the desire for eating. Condiments are employed for this special purpose, and thus a flagging appetite receives a stimulant. Through their aromatic and pungent qualities they also assist digestion, the *modus operandi* being by promoting the flow of the secretions, and increasing the muscular activity of the alimentary canal. In some cases they may be further useful by serving to correct injurious properties that may belong to an article of food." At the same time, however, we are warned against the use of condiments in some abnormal conditions of health, and in all cases against their abuse. They may be indulged in to such an extent that their action on the processes of digestion and assimilation may become probably injurious by vitiating the gastric juice and affecting the coats of the stomach. They

are also provocative of thirst, which leads to the consumption of more liquid of some kind or other than is good for the system even of healthy persons. The golden rule of moderation—*ne quid nimis*—should be observed in their use, both when taken as condiments to the food on our plates, or when employed in cookery. Great chefs, like Beauvilliers, Carême, Ude, Francatelli, and other professors of the mageiric art whose names are household words, have always depended greatly on the use of condiments for their successes ; at the same time, however, they not only observed the proprieties of the combinations of condiments, but exercised great moderation in the quantity of any thing employed. Unfortunately, many cooks incompetent to develop the more subtle flavours of their materials disguise the poverty of their resources with a superabundance of condiments, and especially of the contents of the spice box. All harmony of flavour is thus destroyed, and the digestive advantages which a moderate amount of spice undoubtedly confers are lost in the nausea occasioned by the violation of the *ne quid nimis* principle.

Salt (*Sal*—'αλς) is the most widely accepted of all condiments. So universal has been and is its use, that it may be called the "cosmopolitan" condiment ; and so great is the craving for it and relish of it, that we are led to consider the love of it as one of the most potent of our natural instincts, and salt itself as necessary to the health and even the life of man. The fact that in no part of the world is salt unknown and unused goes far to substantiate this position. It is one of the most important of British minerals, and curiously enough the only one used as a condiment, though other mineral principles are requisite in order to build up the human frame. It is known chemically as *chloride of sodium*, or *sodium chloride*, its two constituents chlorine and sodium being united in the proportion of thirty-six parts by weight of chlorine to twenty-four of the metal of sodium. It has been stated that sodium takes fire when immersed in chlorine gas ; but Professor Wanklyn has shown that,

unless some moisture be present, such is not the case, and it is certain that metallic sodium remains bright for some time, even when immersed in liquefied chlorine anhydride. It is by far the most abundant of all sodium compounds. By the action of vitality, the sodium chloride, in presence of water, is broken up into hydrochloric acid, which is found in the gastric juice, and into soda, or sodium oxide, which is a component of the bile. Salt crystallizes in colourless transparent cubes, which are anhydrous, soluble in about three parts of cold water, and scarcely more soluble in boiling water. A saturated solution has a specific gravity of 1·205, the specific gravity of the salt being 2·125. It is inodorous, insoluble in pure alcohol, and has a purely saline taste, unmingled with bitterness, unless chloride of magnesium be present in it. At a red heat, it fuses, and becomes converted into a transparent brittle mass. The well-known crepitation which occurs when salt is thrown on the fire or otherwise strongly heated, results from the sudden expansion of water mechanically entangled among its particles.

Salt has been in use from the earliest times, and always largely sought after both by man and the higher class of animals. So eager indeed is man for it that at some time or other in almost all nations, when revenue was the most urgent, a tax was placed upon salt, since nearly everything would be sacrificed to obtain a portion of that material; and the saline earths, called "salt licks," are the greatest attraction to the wild animals of the prairie or the desert. Especially among the western nations salt has from time immemorial been regarded as so vital a necessity that no controversy as to its relish or sanitary value was ever for a moment possible. It was used from the first in some such way as water, quite as a matter of course, and with a tacit acknowledgment that it was absolutely indespensable for man's existence. Indeed the desire for salt seems an instinct implanted in the animal creation, and there is a natural craving for it, when it does not exist in sufficient quantity in food. Wild animals will travel long distances

and brave great dangers to get at the salt licks just mentioned; horses and cows are most healthy when provided with lumps of rock-salt in their mangers or pastures; and even bees will sip a solution of salt with avidity. Men will barter gold for it in countries where it is scarce, and for it husbands will sell their wives, and parents their children. In some districts of Africa salt is more expensive than the purest white sugar in Europe, and children will suck a lump of it in preference to sweetmeats. In the district of Accra on the Gold Coast of Africa, a handful of salt is the most valuable thing upon earth after gold, and will purchase a slave or two. Mungo Park tells us that with the Mandingoes and Bambaras the use of salt is such a luxury, that to say of a man "he flavours his food with salt" is to imply that he is rich; and no stronger mark of respect or affection can be shown in Muscovy, than the sending of salt from the tables of the rich to their poorer friends.

But the existence of greater or less appetites for salt in all individuals surely indicates that this substance serves more important functions than that of merely gratifying the palate, a conclusion on which the most elementary considerations of human physiology fully substantiates. Common salt is the most widely distributed substance in the body; it exists in every fluid and in every solid; and not only is it everywhere present, but in almost every part it constitutes the largest portion of the ash when any tissue is burnt. In particular it is a constant constituent of the blood, in which it forms about half the total weight of the saline matters, and it maintains in it a proportion that is almost wholly independent of the quantity that is consumed with the food. The blood will take up so much and no more, however much we may take with our food; and on the other hand, if none be given, the blood parts with its natural quantity slowly and unwillingly. Under ordinary circumstances a healthy man loses daily about twelve grains by one channel or the other, by the secretions, the bile, and even tears, and if he is to maintain his health that quantity

must be introduced. Common salt is of immense importance in the processes ministering to the nutrition of the body, for not only is it the chief salt in the gastric juice, and essential for the formation of bile, and may hence be reasonably regarded as of high value in digestion, but it is an important agent in promoting the processes of diffusion and therefore of absorption. Direct experiment has shown that it promotes the decomposition of albumen in the body, acting probably by increasing the activity of the transmission of fluids from cell to cell. Nothing can demonstrate its value better than the fact that if albumen without salt is introduced into the intestine of an animal no portion of it is absorbed, while it all quickly disappears if salt be added, or, to put it in another way—the necessity for salt may be explained by the composition of the gastric juice. The most powerful solvent acid which insures the digestion of food is that known as hydrochloric. This is furnished entirely by the amount of salt, either chloride of sodium or potassium, taken with the food, or naturally contained in it. Unless a large quantity of this acid is present in the gastric juice, the other digestive principles are inert, or are not given out during the passage of food through the stomach. The immediate effect appears to be to stimulate the sense of taste and to increase the flow of saliva, but its preserving action is due to its power to attract moisture, by which it tends to harden whatever moist substance is brought into contact with it, and when it has obtained moisture it becomes soft, and loses its flavour. There is no other compound of chlorine which effects both of these purposes or could supplant common salt.

Salt should be used in the cooking of all vegetables, and added salt seems almost a necessity to make them palatable when cooked. Said Job (vi. 6) "Can that which is unsavoury be eaten without salt? or is there any taste in the white of an egg?"

The value of salt, as a condiment to be taken by our domestic animals has frequently been made the subject of experiment. A professor of the Michigan Agricultural

College has put it on record that he gave three bullocks salt with their food and three were kept without it. There was no other divergence in the treatment of them, but at the end of six months a marked difference began to be observable between them, and finally the animals without salt sickened and fell away, while the others continued in excellent condition. Further interesting experiments on animals by Boussingault have shown that, although salt mixed with the fodder does not much affect the quantity of flesh, fat, or milk obtained from them, yet it seriously affects their appearance and general condition; for animals deprived of salt, other than that contained naturally in the food, soon get heavy and dull in their temperament, and have a rough and staring coat. Meulin states that animals which do not find it in their food or drink, become less prolific and the breed rapidly diminishes in number. This is confirmed by Dr. Le Saine, who says, in his prize-essay on salt, that it increases the fertility of the male and the fecundity of the female, and it doubles the power of nourishing the fœtus. During the period of suckling, also, salt given to the mother renders the milk more abundant and more nutritious. It likewise accelerates growth, and gives a finer condition to the skin; and the flesh of animals fed with it is better flavoured, and more easily digested, than that of animals which do not partake of it.

The value of salt may be further estimated by the consideration of the effect on health from being unable to procure it. In barbarous times, the most horrible of punishments, entailing certain death, was the feeding of culprits on food without salt. By the old criminal law of Holland it was decreed that criminals convicted of murder under certain circumstances should be imprisoned in a damp cell, have only water to drink, and should be fed with bread made without salt. According to well-authenticated testimony the criminal always died within a very short time, and that by a death so loathsome and horrible that its symptoms cannot very well be described. It is calculated that the annual salt consumption per head in

this country amounts to 16 lbs., and that of this the average bread eater unconsciously takes 2 oz., per week, salt being a necessary ingredient in proper bread-making. Hence we can in a measure realize what the effect of bread without salt would be. Certain experiments of the French Academicians showed that flesh deprived of its saline constituents by being washed with water, lost its nutritive power, and animals fed on it soon died of starvation. Even after a few days, with such a diet, the instincts of the animals told them it was worthless as food, and they fed on it with reluctance; indeed, for all purposes of nutrition, it was, as Liebig says, "no better than eating of stones," and the utmost torments of hunger were hardly sufficient to induce them to continue the diet. There was plenty of nutritious matter in the food, but there was no medium for its solution and absorption, and hence it was useless.

The above considerations would almost seem to suggest that salted meat would be a wholesome and desirable article of food; but it is not so. The case stands thus. The application of salt to fresh meat has very much the same effect as the application of a quick heat. It causes the fibres to contract, the meat to lessen in bulk, and the juice to flow out from its pores. Hence the reason why dry salt strewed upon fresh lean meat gradually dissolves into a fluid brine. If a large quantity of salt be applied, it penetrates so deeply that as much as one-third of the juice of the meat is often forced out by the contraction of the fibres. The effect of this upon the meat is two-fold. It diminishes the natural flavour, by removing a large proportion of the peculiar substances contained in the juice, and adding pure salt in their stead. At the same time it closes up the pores of the meat, and prevents the entrance of atmospheric air, thus diminishing the liability to decay. Thus there is a diminution in its nutritive qualities, for the juice which flows out contains albumen (white of egg), kreatine, phosphoric acid, and potash: and in proportion as these are extracted the nutritive properties of the meat are diminished. Hence one reason why long feeding on salt

meat affects the health, and why vegetable and other substances which are capable of supplying what the meat had lost, are found to be the best means of restoring it. Vegetables contain potash-salts and but little common salt, and we cannot live on them alone without adding common salt. So, on the other hand, we cannot maintain our health on salted meats unless we restore the potash-salts which they drive out of the body. As a whole, flesh-meat is eminently nutritious, because it contains *all* the materials which are necessary to build up our own flesh; but remove from it a portion of these materials, and the remainder becomes more or less useless, as bricks and stone become useless to the builder if we refuse him the requisite quantity of mortar. The analysis of the brine round salt meat shows that the process of salting must materially diminish the nutritive value of meat, for it is found to contain a large portion of the ingredients of its juice. Not only does the contraction which ensues cause the infiltrating liquid to be driven out, but the liquefied salt tends further to draw out by osmosis its diffusible organic and saline constituents. Liebig estimated the loss of nutritive value as amounting to one-third or even one-half. Soaking salted meat in water removes its saltness, but cannot of course restore the nutritive principles that have been lost. From experience it has been learnt that salted and dried food cannot be used continuously for a lengthened period without impairing the health. The well-known effect is the development of a cachectic state which manifests itself under the form of what are called scorbutic affections.

But notwithstanding the general consensus of scientific opinion as to the great value of salt, confirmed as it seems to be by physiological facts, and it may be added by our natural instinct, there are found persons who take an opposite view; and even an authority like Dr. Hassall has made bold to publish the following statement. "The function" he says "of chloride of sodium or common salt, is but ill understood. It has been asserted that it is necessary for the assimilation of the food, but this seems

not to be the case. Salt, in fact, is considered by some to be quite a superfluous addition to most of our articles of food, and nothing more than a condiment. It does not enter into the composition of any of the tissues, but is thrown out of the system in the excretions; and it has been repeatedly shown that some tribes of natives of Africa do not know the use of salt at all, or consider it a luxury and delicacy." But others have gone still further and mentioned that the use of salt is absolutely injurious. The present writer has in his possession a very curious volume of over a hundred pages, written by a Dr. Howard some fifty years ago, the protracted title of which indicates its object. It runs thus:—"Salt, the Forbidden Fruit, or food; and the chief cause of diseases of the body and mind of man, and of animals; as taught by the ancient Egyptian priests and wise men, and by Scripture; in accordance with the author's experience of many years." The work elaborates the view that salt is the source of almost "all the ills the flesh is heir to," and that abstention from it is their cure; and it is not too much to say that the writer is a painful instance as to the length people will go in perverting historical and other facts, and texts of Scripture, when they have once become the subject of a "craze," and dubbed themselves apostles of a movement. Unfortunately such extremists will ever be found, and the present age seems particularly prolific of them, whether the crusade be against the use of animal food, of tobacco, or of alcohol, or against vaccination. With such it is of little avail to adduce facts or arguments. They admit nothing which tells against their views; they contort and pervert everything; and the "Counterblast" of King James is their only type of reasoning, if reasoning it may be called. In this matter of salt some few are indeed more temperate, and state their views more moderately and intelligibly. This, for instance, is how one of the opponents of salt eating puts the case, though with no little misconception of physiological facts. "We have," he says, "among us physiologists of no mean standing who regard

mineral salt as a poison, and as the predisposing cause, therefore, of many ailments. It is true that in its passage through the system salt remains unchanged, but this is only to say that it exerts upon the substances with which it is mingled in the system, the same antiseptic qualities that it does outside the system. That is, to a greater or less extent, it prevents food from decomposing, and therefore from turning into nourishment. It is for this reason that salt is, as it notoriously is, a provocative of scurvy—a complaint which consists mainly in poverty of blood through lack of nourishment owing to the action of salt. It may be granted that a diet of flesh requires a certain small amount of salt to retard the process of digestion and assimilation, which otherwise would be too rapid, flesh not being the natural food of man, who, in all physiological respects, is a grain and a fruit-eating animal. But with our natural diet salt is worse than superfluous, saving only for the fact that we have become so accustomed to it that we do not like our food without it." That such views are held by a certain number of persons in this country may be admitted, and recently there seems to have been an attempt to organize something in the way of an anti-salt association, the members of which were to abstain from salt themselves, and to endeavour to gain converts to their opinions and practice. Some years ago there was established in New York a medical "College," the prime tenet of which was abstention from salt.

One of the chief arguments against its use was that adduced by Dr. Hassall in the quotation from his work on the Adulterations of Food, to the effect that some people exist without it. Other instances might be added to that given by Dr. Hassall. The Damaras, in South-western Africa, never take salt by any chance ; and even Europeans travelling in their country never feel the want of it. But the well-water in Damara land is nearly always brackish or saline, though it appears to taste rather of carbonate of soda than of the chloride. Their neighbours, the Namaquas set no store by salt ; the Hottentots of Walfisch Bay hardly

ever take the trouble to collect it ; and even the wild game in the Swakop do not frequent the salt-rocks to lick them as they do in America. One tribe of New Zealanders hold salt in abhorrence. In the colds of Siberia, also, as in the heats of Africa, a similar disregard of salt sometimes prevails. Most of the Russians at Berezov eat their food without a particle of salt, though that condiment can easily be obtained at a trifling cost. Their soups, vegetables, and even roast meats, are prepared and eaten without salt. The explanation of these cases, so inconsistent with our general experience, is found in the refined instinct of the body itself. When the food we usually eat conveys a sufficiency of salt into the body, it has no occasion for more. It therefore feels no craving for it, shows no liking to it, and takes no trouble to obtain it. And doubtless, in the kind of food and drink consumed in the Damara country, and by the Russians of Berezov, either more salt, or more of sodium and chlorine, in other combinations, than is usual among us, is conveyed into the stomach, or their habits render less salt necessary to them, or cause less of it to be daily removed from their bodies. A similar explanation will to a great extent account for the cases of individuals, probably known to most of us, who take no added salt to their food, and yet seem to enjoy good health. Either some idiosyncracy of constitution, or some special habits, or some special line of diet, or all these combined, enable such persons to live without conscious discomfort on food not artificially salted.

The case, so to speak, against salt has been here stated, partly because a handbook like the present is not intended in connection with such a topic as this to advocate any particular view, but rather to put before readers a conspectus of what has been, and may be said on the subject, and to suggest that any controversial matter connected with our Health might be submitted to further investigations. At the same time, however, after considering the history and "science" of salt, which seem to point convincingly to its almost universal use, and to the benefits which have as

universally resulted from it, it is almost impossible to conclude otherwise than that this cosmopolitan condiment is wholesome and necessary, and that abstention from it is likely to be injurious—in a word, according to the trade mark of an eminent salt manufacturer, SAL EST SALUS, "Salt is Health."

As regards the quantity of salt which may be eaten with impunity, it is reassuring for those who use it in what may be deemed excess to know that the blood, as before intimated, will only take up a certain amount and no more. What salt is consumed in excess of this, the human system gets rid of by various means, mainly through the secretions, and through the pores of the skin by perspiration naturally or artificially produced. Any one who has made the experiment of tasting knows that the "tears of heat" as well as the tears of grief are very briny, and that after evaporation perspiration leaves on the skin and on the clothing an incrustation of actual salt, which may be collected in an appreciable quantity. It is possible, however, to eat salt in such enormous quantities as to produce very injurious results: but this is also the case with many other substances perfectly harmless and wholesome if taken in moderation.

But not only has the great majority of mankind long endorsed the above motto "Salt is Health;" but a belief in its actively medicinal virtues in many cases has always had a large number of adherents. For both inward and outward application it has been used in a variety of ways; and it has been found useful for clysters and emetics, and, when heated, for outward application to toothache and other local pains; but more efficacious substitutes have now been found for it. If not an actual vermifuge the popular notion that the use of salt prevents the development of worms in the intestines has a foundation in fact, for salt is fatal to the small threadworms, and prevents their reproduction by improving the general tone and the character of the secretions of the alimentary canal. Some years ago there was a very widely spread craze for a mixture of brandy and salt for almost every ailment; but it probably fell into dis-

favour, as least in the eyes of those who recommended it when it was found that patients too often drank the brandy and left the salt. In recent years the Brine Baths at Droitwich have gained considerable reputation. It was remarked that during the cholera visitation in 1831, the operatives employed at the Droitwich Salt Works enjoyed an immunity from the disease. This was attributed to the fumes of the brine, more especially when it was found that certain cholera patients sent to Droitwich quickly recovered on being immersed in the hot brine. Since then the baths have been much resorted to by persons suffering from gout, and it is said that large numbers have derived considerable benefit from them. The baths form part of the Royal Brine Bath Hotel establishment.

Baths made from sea salt are recommended for many cutaneous affections, and to persons suffering from various ailments, while many in good health find great advantage from their use. Some excellent samples of sea salt for such baths can be seen among the interesting salt exhibits of Messrs. Bumsted & Co. (King William Street, E.C.), in the Southern Gallery of the Health Exhibition.

Though perhaps hardly within the scope of our immediate subject, an important connection between salt and our water supply may be here mentioned. Certain chemical tests will show when there is too much salt in water. Salt does not occur in rain water except in almost infinitesimal quantities, or in pure well water, except to the extent of little more than a grain a gallon. When therefore chloride of sodium and sulphate of lime are found present in water to a large amount, together with any considerable quantity of certain organic matters, we may, as a rule, safely pronounce the water to be impure and to have been subject to sewage contamination.

CHAPTER II.

THE SALT SUPPLY OF THE WORLD.

SALT in some form or other is so widely distributed throughout the world that hardly any region is without it, and facilities for obtaining it in greater or less abundance are within the reach of the large majority of mankind. The waters of the ocean which wash so many shores can easily be made to yield it, and masses of rock-salt more or less accociated with brine springs, yield an enormous and practically inexhaustible supply; while inland salt lakes, and various soils largely admixed with salt also contribute their quota. In a word, as an old writer puts it, "salt is dispersed over all nature; it is treasured up in the bowels of the earth; it impregnates the ocean; it descends in rains; it fertilizes the soil, it arises in vegetables and from them is conveyed to animals; it is friendly and beneficent to all creatures endowed with life; and may well be esteemed the *universal condiment* of nature;" and as Dean Buckland in his "Bridgewater Treatise," speaking of rock-salt as the chief source of supply, says, "Had not the beneficent providence of the Creator laid up these stores of salt within the bowels of the earth, the distance of inland countries from the sea would have rendered this article of prime and daily necessity unattainable to a large portion of mankind; but under the existing dispensation, the presence of mineral salt in strata which are dispersed generally over the interior of our continents and large islands, is a source of health and daily enjoyment to the inhabitants of almost every region of the earth."

Apart from other sources, as rock-salt directly or indirectly, through the connection between it and brine springs,

yields the great bulk of the salt supply of the world, its formation at various depths below the surface of the earth is a very interesting geological question, which can hardly be passed over without some little notice. Probably at no period of the earth's existence did the formation of salt deposits proceed with the same activity as during the Triassic, and it is in the New Red Sandstone, Bunter Sandstone, or Keuper, and in the red or variegated marls of the Trias, that most rock-salt occurs. An idea that all rock-salt was referable to that epoch long prevailed amongst geologists, but it is now generally admitted that, although salt is found most abundantly amongst Triassic rocks, and becomes rarer as we descend into the earlier strata, it occurs in all the so-called sedimentary rocks. The oldest deposit of rock-salt known to exist, whose geological age may be said to be positively determined, is the Salt Range of the Punjaub, which may with tolerable certainty be referred to the Permian, while the deposits lately discovered at Middlesborough-on-Tees may also probably be referred to this period, as they immediately overlie the magnesian limestone.

The stratified nature of all salt deposits with their interposed beds of clay, and the salt rock itself generally possessing a perfectly stratified structure, as well defined as any other rocks of known aqueous origin, point to the fact that rock-salt must have been deposited from solution. The large quantity of selenite (crystallized hydrated calcium sulphate) so constantly found interstratified and intimately mixed with rock-salt, is, in itself, an almost conclusive proof of its marine origin, for selenite is a hydrated mineral, losing its water at a temperature far inferior to that at which sodium chloride fuses: and crystals of selenite could hardly have found their way into the solid mass of the salt, unless they had been deposited from solution simultaneously with the salt itself. In subsequent times, should the surface of the mixed bed be denuded or dissolved by the action of water, the salt would be carried away, leaving a bed of gypsum, such as is constantly found overlying and

surrounding rock-salt deposits. In some districts, as those of Magdeburg, Stassfurt, Vic, &c., beds of potassium and magnesium salts are found overlying the rock-salt. Sea-water contains similar salts, which on its being slowly evaporated are deposited in the same order as, and in similar forms to those found in connection with these German salt formations. Supposing the existence of a great Triassic estuary or lake becoming in the lapse of ages completely dried up, it is easy to imagine how the formation of these German deposits took place. Beds of salt would be formed, while the inland sea from which they were produced would become continually enriched with successive accessions of salt washed by floods from the salty soil of the surrounding country, and streams would also bring down clay and mud, so that in course of time layers of salt would be formed interspersed with beds of clay, and they might ultimately become covered up and protected by this same clay deposit. It is remarkable how frequently erupted rocks and hot springs are found in the neighbourhood of salt deposits; but this need not be taken as pointing to a volcanic origin for the salt itself. It is easy to understand how depressions and elevations produced in the earth's crust by disturbances due to volanic phenomena would tend to the formation of estuaries and inland seas favourable to the production of salt; and many such disturbances and eruptions probably occurred during the time when the ocean bed was being raised and became dry land. Further it is to be noted that most trappean rocks are rich in iron, often ferric sulphide, whilst they are easily disintegrated by the combined influences of moisture and atmospheric oxidation. Salt itself assists in promoting such decompositions, so that islands or cliffs of trap on exposure would tend to crumble down and decompose, and under the action of the briny waves of such a sea, some of the iron present might temporarily dissolve as ferrous sulphate, accounting for the frequent red colour of rock-salt. Any sulphur combined with the iron would be oxidized to sulphuric acid, and go to augment the gypsum

derived from the sea-water by combining with lime from the surrounding strata, while the crumbled trap, subsiding as clay, and becoming interstratified with gypsum, would wrap up the salt in a protective covering, and preserve it from re-solution.

Another noticeable and not easily accounted for feature in the geology of rock-salt is its frequent association with bitumen and petroleum, which are found with salt in the oil formations of Pennsylvania and elsewhere. Bastennes, where bitumen was long worked, is close to the salt deposits of Dax, at the foot of the Pyrenees; and petroleum floats in small quantity on the surface of a spring near Orthez, and has been found in a boring in the neighbourhood of Salies, in the same district. Petroleum and bitumen also occur not far from Volterra, in Tuscany, where the largest rock-salt works of Italy exist, and near to which are Count Larderel's celebrated boracic acid springs; and they are worked in some quantities in Wallachia, where also much rock-salt is found. Petroleum has lately been discovered in Hanover, not far from the German salt deposits already mentioned. Bitumen colours the lowest beds of the rock-salt mines of Nancy. It is found in and around the Dead Sea in numerous places, while both bitumen and petroleum occur abundantly at Baku, on the Caspian, near some large salt deposits both old and recent. A good deal of organic matter, both vegetable and animal, exists in the sea, and as its waters become concentrated, such organic matter would concentrate with them. Such facts testify strongly to the theory that rock-salt is a true sedimentary rock, and that it probably owes its origin to the slow evaporation, in the course of enormous lapses of time, of salt lakes or inland seas fed from the waters of the ocean. The sea as it now exists may owe some of its saltness to the solution of rock-salt formed during previous geological periods, and subsequently depressed beneath the present ocean. Probably such cases of solidification and re-solution have been frequently repeated, but that the present known formations

of rock-salt owe their origin to an evaporation of salt-water, such as is now going on in certain quarters of the globe, as for instance, on the shores of the Caspian Sea, rather than to any eruptive agency, there can be hardly any room to doubt.

Taking a detailed but hasty glance at the salt supply of the world, we find that Europe is well provided with deposits of rock-salt, and brine-springs. The Carpathian district is the richest and most extensive, and it is calculated that its deposits of salt would alone be sufficient for the supply of the whole continent for several thousand years. This district may be divided into the Moldo-Wallachian, Transylvanian, Galician, and Hungarian sections. The salt-mines of Wallachia are very noted, and the salt is distributed by means of the Danube and its tributaries, over a very large district. The salt used is the rock-salt, as is generally the case throughout the district of the Carpathians. Owing to the absence of cheap fuel, and the tolerable purity of the rock-salt, very few attempts to manufacture white salt have been made, and millions of gallons of nearly "saturated" brine are allowed to run to waste. Transylvania is richer in rock-salt than any other portion of Europe. It consists of a central basin, that of the Maros river, and the basins of the upper courses of the Számos and Alt rivers. The whole territory is more or less mountainous, and the deposits of rock-salt are frequently found along the banks of the small rivers amongst the hills. The supply of salt is inexhaustible. The great centres of salt-mining are Máros Ujvar, on the Máros river, most favourably situated for water communication, and hence the largest shipping town in the district, exporting seventy per cent. of the Transylvanian salt. The Galician district extends along the N. and N.-E. slopes of the Carpathians, from Moldavia to Moravia. There are numerous mines and brine-springs scattered at intervals along this district. The most celebrated salt-mines in the world, and those longest worked, are the mines of Wieliczka and Bochnia, at the extreme west of Galicia.

Together they produce annually 45,000 tons of salt. The mines at Wieliczka have been worked since the 13th century. The Hungarian salt district is very extensive, but almost wholly confined to the region of the Carpathians, from the borders of Transylvania to Moravia. One of the largest tracts lies in the basin of the Számos, in the neighbourhoods of Szathmar and Szigeth, and in the neighbouring districts of Marmaros. In the localities of Soovar and Szlec, in the extreme north of Hungary, there are numerous mines.

The district of the Austrian and Bavarian Alps is probably the best known salt district of Europe to ordinary travellers. The most important mines and springs lie in a comparatively small area, in the upper parts of the basins of the Traun and Salza, and partially in the basin of the Inn. The most celebrated region is the Salzkammergut, lying on both sides of the river Traun, on the borders of Styria and Salzburg. The salt is chiefly manufactured. In many cases, water is allowed to run into the rock-salt mines, and to become saturated brine, then drained off, and manufactured, many miles away. The district extends into Bavaria, along the valley of the Salza. The most important salt towns in the Austrian portion are Aussee, Ischl, Hallstätt and Hallein. The Bavarian portion is very rich in salt, the chief towns being Berchtesgaden, Reichenhall, Traunstein and Rosenheim. The last-named manufactures the salt from brine conveyed in pipes from Reichenhall. This Alpine district extends into the Tyrol. At Hall, near Innsbruck, in the Inn valley, are very extensive salt deposits and salt-works, and the rocks are similar in character to those of the Salza and Traun. In Austro-Hungary the rock-salt is generally retailed in lumps, but some is ground and sold in that form at the shops in towns. Its price differs in various parts of the kingdom, according to the distance from the centres of its production, varying from 1d. per lb. near the mines, to 1½d. per lb. at distances from them. In both parts of the Empire the salt trade is a government monopoly, producing

Austria a profit of two millions sterling of our money, and in Hungary a million and a quarter. A considerable quantity of Austro-Hungarian salt is sent into Italy, where salt is dear in consequence of the duties laid upon it.

In Germany there are a very large number of salt-mines and brine-springs extending from Segeberg, in Holstein, in the North, to Sulz, on the Neckar, in Württemberg, on the south, and from Kreuznach on the Nahe, on the west, to Halle near Magdeburg, on the east. The district between the Elbe and Weser contains very large quantities of salt, and springs of brine are met with in great numbers, from the banks of the Werra and Saale, to those of the Aller. The most numerous springs, as also the rock-salt deposits, lie near the various small ranges of mountains that are scattered about the district, as the Thuringer Wald, Harz Mountains, Tentoberger Wald, &c. Two localities of special importance are the district between Magdeburg and Halle, more especially in the neighbourhood of Stassfurt ; and the Luneberg Heath in Hanover, to the south of Hamburg. In both localities brine-springs have long been known, and Schönebeck and Luneberg have been centres of salt manufacture for a considerable period.

The Vosges district is a very important one. Its salt meets English salt very extensively in Belgium. Great portions of E., N., and Central France are supplied from it. Until the late Franco-German war, the district belonged wholly to France, but lying in the ceded district of Alsace-Lorraine (principally in Lorraine), now belongs to Germany, thus rendering Germany the possessor of some of the most extensive salt deposits in Europe. The salt is chiefly manufactured from brine-springs, though a considerable quantity of rock-salt is mined at Vic, and at Varengeville, near Nancy.

Since France has lost the salt district of the Vosges, the long-noted one of the Jura has become of more importance. It is separated from that just mentioned by the Plateau of Langres, and lies in the basin of the Saône and Doubs. The salt-springs of Salins have been noted from remote

antiquity. The chief centres of manufacture are Salins, Arc, Lous le Saulnier, Montmorot, and Saulnot.

In Switzerland a small salt district lies on the right bank of the Rhone, just before the river enters the Lake of Geneva, in the Canton de Vaud. It has rock-salt mines and brine-springs. The chief centres are Aigle, Bex, and Roche. Rock-salt was mined here 300 years ago.

Like the Carpathians, the Pyrenees are rich in rock-salt deposits and brine-springs. In the west district of the Pyrenees, in both France and Spain, salt appears to be most plentiful. In France, the basin of the Adour is the most important district, and contains the towns of Salies de Béarn, Briscous, and Villefranche. At Salis d'Arbas, on the Garonne, near the Pyrenees, a brine-spring exists, and salt is manufactured. In Spain, the whole basin of the Ebro is rich in salt, especially towards the source of the river, as is indicated by the number of villages named either *sal* or *salinas*. In one small district, are Salinas, Salinas d' Amana, Salinillas, and Poza de la Sal. On the banks of the Ebro, are Mendavia, Valtierra, Remolinos, and Sastag. Both rock-salt and brine-springs are plentiful. One of the most peculiar deposits of rock-salt known to exist is in this district, about 45 miles N.-W. of Barcelona, on the banks of the Cardona river. This is the famous rock-salt mountain of Cardona, a hill composed entirely of rock-salt, which is worked in open quarries like stone. There are indications of salt in various other places ; and indeed Spain seems richly endowed with this mineral.

Some other more or less isolated salt-deposits and brine springs may also be mentioned. For instance, in France, at the foot of the Alps, at Moutiers and Castellane, are well-known brine springs from which salt is made. In Italy, at Volterra, in Tuscany, salt is manufactured ; and at Lungro and Altamonte, in the Mountains of Calabria, rock-salt is mined. In Sicily, at Nicosia and Mussomeli, are salt deposits. At Szamobor, in Croatia, and Tuzla, in Bosnia, salt is found. In Russia, at Bachmutz, on the Donetz ; Balachna, on the Volga ; Staraia Russa, near Lake

Ilmen; Solikamsk, on the Kama; and at Hetzkaya, salt deposits exist. At Eupatoria, in the Crimea, rock-salt is found. In Prussia, at Jnowraclaw, Rawicz, Waltersdorf, brine-springs exist; and at Sperenberg, South of Berlin, a bed of rock-salt, of the enormous thickness of 2810 ft. was bored into in 1870.

Deposits of rock-salt have not hitherto been discovered in the United States of America, although their presence seems to be indicated by numerous salt-springs. In the central States these springs are very common, particularly in Arkansas, Virginia, Ohio, and Kentucky, and also in Pennsylvania and New York. Throughout North America the term *Lick* is applied to those marshy swamps where saline springs break out, and which are frequented by deer, buffaloes, and other wild animals for the sake of the salt, whether dissolved in the water, or thrown down by evaporation in the summer season, so as to encrust the surface of the marsh. Cattle and wild beasts devour this incrustation greedily, and burrow in the clay impregnated with salt in order to lick the mud. The manufacture of salt from brine is carried on mainly after the method pursued in our own salt districts, which will be described in Chapter IV.; the brine being mostly obtained by boring where there are indications of salt. A similar remark applies to Canada. But North America will probably look to us for its main supply of the best table salt for some years to come.

Rock-salt is found in different parts of South America.

Looking further a-field we find numerous lakes of salt-water in the steppes of Asiatic Russia, Lake Inder alone containing such an abundant supply of salt of the first quality, that it would suffice for the consumption of "all the Russias," if the difficulties attending the carriage were not almost insurmountable. China, like North America, bores for brine, of which it seems to have a fair supply. In the province of Szu-Tchhouan, on the borders of Thibet, occur a number of salt-wells with the remarkable accompaniment of springs of inflammable gas; so that nature not only

furnishes the brine, but also the fuel for evaporating the water and extracting the salt. There are several other wells of the same nature in the different districts of this department of Kia-Ling-Fou, and in the other neighbouring districts, situated to the east of the great chain of mountains covered with perpetual snow, which traverses the eastern part of Szu-Tchhouan, from south to north. But of all the countries in Asia, Persia is the most abundantly supplied. All the lakes are salt, and every considerable collection of water is impregnated with it. Salt-mines also are found in different parts, and salt-deserts are a striking feature of Persian scenery. There are salt-mines in Morocco, but the product is of a red colour, very strong and coarse. The lakes of Barbary are almost all as salt as the sea, and in the course of the summer may dry up entirely, leaving the mineral incrusted on their beds: and near the lake of Marks, in the Algerine territory, is a mountain composed entirely of salt. Salt-water lakes abound also in Southern Africa.

British India, considering its vast extent, can hardly be said to be well supplied with what may be called inland salt. The bulk of this is obtained from the evaporation of the water from the Sambhur Lake, and from the Punjaub Rock-salt mountains. This extensive range of mountains stretches from the base of the Suliman mountains in Afghanistan, in an easterly direction, to the river Jailum in the Punjaub. It is known to the natives in different parts by many different names; but among Europeans it has acquired the general term of Salt-range, from the great extent and thickness of the beds of common salt which it in many places contains. One is 200 feet thick, and the salt varies in colour from white to flesh-colour and brick-red. In addition to the supply from these sources, salt, from the evaporation of sea-water, is obtained along thousands of miles of coast. But India, like North America, will take large supplies of salt from us for some time to come, and probably in increasing quantities; some remarks on which branch of our salt trade will be found in Chapter VI.

Some remarks also on the production of salt from sea water will be found in Chapter V.

We now come to the English salt-producing districts, which though very prolific, are of limited extent: but, as these and their salt production will be treated of in the following chapters it will suffice here merely to mention the chief centres of rock-salt and brine-springs in this country. These are Northwich, Middlewich, Winsford, and Sandbach, in Cheshire, the basins of the rivers Weaver and Wheeloch mainly forming the salt district; Stoke Prior, and Droitwich, in Worcestershire; to which may be added Weston-on-Trent in Staffordshire. At Duncrue, near Carrickfergus, in Ireland, there is an important rock-salt deposit. At Middlesborough-on-Tees, another valuable deposit of rock-salt exists, and at Chester-le-Street, in Durham is a brine-spring. Indications of salt are also to be met with in Shropshire, and Lincolnshire.

It is probable that the production of salt will be still further developed at the centres in Ireland, Yorkshire, and Durham just above mentioned. It was not till as recently as 1851 that rock-salt was discovered at Duncrue, when a trial shaft was being sunk in the hope of finding coal on the Marquis of Downshire's estate. Consequent upon this discovery new shafts were sunk by the Belfast Mining Company and Mr. Dalway, and the deposits have been worked ever since. Another "Winning" was commenced in 1884. Some statistics in reference to the production of Irish rock-salt will be found in Chapter VI.

The rock-salt deposit at Middlesborough was only discovered in 1862, when Mr. John Vaughan, of Bolckow and Vaughan, bored for water on the south bank of the Tees, for feeding his steam boilers, and struck the salt at a depth of 1,200 feet. The firm subsequently endeavoured to work the deposit by means of a shaft, but soon abandoned it, on account of the heavy cost. In 1874 Messrs. Bell Brothers sank a bore-hole on the north side of the river, and found the salt at a depth of 1,127 feet, or 73 feet nearer the surface. This deposit exists in the palæozoic series,

overlying the coal measures, and is about 3,000 feet lower, and considerably older, geologically, than the Cheshire salt, which is found entirely in the triassic series of rocks. The theory of its formation is that the salt water, in isolated basins cut off from the sea, or communicating with it by narrow entrances only, was gradually concentrated, until it became saturated. The extent of the bed has not been ascertained ; and all that is known at present is that it rises to the north, and dips to the south. The thickness, however, as proved by a second bore-hole put down by Messrs. Bell in 1881, is 65 feet, warrants the estimate that salt is present under Middlesborough in the proportion of 200,000 tons to the acre. In Cheshire, the surface water trickles through the clay to the gypsum, and flows over the salt, which is thus converted into brine, and only requires being raised to the surface ; but, in the Middlesborough deposit, the nature of the strata and the great depth preclude all chance of infiltration. It occurred, however, to Mr. Thomas Bell, that the salt might be raised by allowing fresh water to flow into the hole and become saturated with salt, and then pumping out the brine, without sinking a shaft. Accordingly, the bore-hole was put down successfully by the rotary diamond drill; and it so happened that a portion of the lowest core was left at the bottom of the hole, leaving an annular space, which has served to receive the lower end of the lining tube. This latter is perforated with holes where it passes through the salt ; and the greater portion of its weight is carried by a ring resting on the surface. An inner tube, perforated for a short distance at the bottom, is supported partly by a plate at the bottom and partly by girders at the top. There is an annular space between the two tubes, into which fresh water is allowed to flow. This water makes its way out through the holes in the outer tube, becomes saturated with salt, and rises in the inner tube, but only to such a level that the two columns bear the proportion of ten to twelve, hat being the relation of the specific gravities of brine and water. The pump is, however, placed below this level, so as

to avoid the necessity for suction. The pump, worked by an engine at the rate of 14 strokes a minute, lifts from 8 to 9 gallons of brine at each stroke. When the cavity in the salt bed at the bottom of the hole has attained a certain size, the following is supposed by Mr. T. Hugh Bell to be what takes place. A molecule of water, descending the annular space between the two tubes, reaches the upper cavity in the salt, and there finds saturated brine. It, therefore, no longer continues its downward course, but floats on the surface of the heavier fluid, having no tendency to sink until it becomes saturated by coming into contact with the undissolved rock-salt. The cavity at the bottom is, therefore, filled with a solution of salt, saturated, or nearly so, with fresh water flowing along its surface, and which gradually becomes saturated in turn. The pump draws the saturated solution from the bottom of the hole, and makes room for fresh water on the surface, so that there is a tendency for the hole to become enlarged at the bottom, and assume the form of a very flat inverted funnel. The brine is pumped into a reservoir containing 500,000 gallons, and, roughly, between 500 and 600 tons of salt, the salometer standing at about 23°. Thence it flows into twelve shallow evaporating pans, nine of which are heated with coal, and three by the waste gases of the blast-furnaces adjoining, the temperature of the brine being kept at 170°. The salt crystallises in regular cubes, which float on the surface; and on each cube is formed others, until the whole mass becomes too heavy to float, and sinks to the bottom. Some difficulty was experienced in a thin pellicle forming on the surface, which prevented the crystals from falling, and also arrested evaporation. This was found, on investigation, to be due to gelatinous vegetable matter, which was present in the surface water used; but upon water from the Darlington Waterworks being substituted, the difficulty ceased. Salt is taken out every other day upon platforms, called "hurdles" between the pans, and conveyed in barrows to railway waggons. A scale of sulphate of lime forms on the bottom of the pans, which requires removing at intervals,

and also necessitates the laying off and thorough cleaning of the pans every three or four weeks. The twelve pans some time ago produced 360 tons a-week of coarse salt suitable for curing purposes and for chemical works, table salt requiring to be crystallised at a much higher temperature. The firm are now turning their attention to the utilisation of the brine, as it comes from the bore-hole, for making carbonate of soda. They are also making preparations for putting down another hole, to be ready in the event of the existing one failing, through a fall of the roof, or the tube being destroyed.

The utilization of the large deposits of salt that have been known for twenty years to exist in South Durham has been for some time in progress. The brine from the bore-holes has been converted into salt, large quantities of which have been sent to some of the alkali works on the river Tyne. It has been sold at rates as high as that from Cheshire; so that, when the difference between the cost of carriage is borne in mind, the price of the South Durham salt must be profitable to its producers. It is impossible as yet to state what the effects of the utilisation of these deposits will be, as they are believed to extend from Middlesborough under the river Tees, to somewhere not far from West Hartlepool. If anticipations be realized there will be a great change in the position of the Tyne chemical trade. It will ultimately obtain cheap salt, and it is probable that on the low-lying and not fertile shore between the Tees and West Hartlepool large chemical works will be soon erected.

CHAPTER III.

ROCK-SALT, AND BRINE IN THE ENGLISH SALT DISTRICTS.

SALT was produced from the brine-springs in the Cheshire and Worcestershire salt districts at a very early period of our history, and it would seem that all places where such springs or brine-pits existed, were called by the name of *Wich*, a termination that still distinguishes most of the salt towns at the present time. The name Droitwich, it seems, was originally *Wich*, and it is supposed that the prefix *Droit* was given to designate a certain legal or allowed brine-pit. Some of the earliest records of the brine-springs relate to those of Droitwich. It appears that in the year 816 Kenulph, King of the Mercians, gave Hamilton and ten houses in Wich, with salt-furnaces, to the church of Worcester; and about 906, Edwy, King of England, endowed the same church with Fepstone and five salt-furnaces, or scales. William the Conquerer caused an inquiry to be made into the names of the several places, and by whom they had been held in the time of Edward the Confessor, and found the Wiches and salt-houses then in operation recorded. Henry III. caused the brine-springs to be destroyed, to prevent the Welsh, with whom he was at war, from getting supplies of salt. Later on there were 216 salt-houses at Nantwich. In 1671 it appears that at Winsford two salt-works were in operation, and in 1808 Dr. Holland described the brine-springs of Cheshire. In Staffordshire, also at Shirleywich and Weston-upon-Trent, salt was made from brine in early times.

Salt is obtained either in a solid state from Rock-salt mines, or from the evaporation of the water from the brine-pits or springs; and though the latter have been worked from the earliest periods in the history of this country (part

of the pay of the Roman soldiers being in salt, giving rise to the word *salarium*, "salary"), the deposits of fossil or rock-salt were not discovered till the year 1670, when in the process of searching for coal in Marbury, about a mile to the north of Northwich, a stratum of rock-salt was hit upon, about thirty yards thick, and about thirty-four yards below the surface of the ground. In 1779, rock-salt was discovered near Lawton in three strata, with beds of indurated clay between them, the lowest stratum producing the purest salt. The Marstone mine at Northwich is the largest in the kingdom ; and in 1781 its owners instituted lower sinkings, which resulted in what is now known as the "bottom of the bed" of rock-salt. The old shaft by which the bottom bed was thus proved still remains, and the workings that were made from it in the bottom bed still form a part of the present Marston mine ; but the work at the bottom mine has long been carried on by shafts sunk direct from the surface. The depth to the floor of the bottom bed is 110 yards at Northwich, and at Winsford, a few miles distant, 159 yards. The two beds of rock-salt in the Marston mine, are each from 28 to 30 yards in thickness. Further explorations show that more rock-salt lies below what is called the bottom bed, but it is in thin strata and irregular masses, none of which have yet been worked. The sites of most, if not the whole, of the old rock-salt pits appear to be known, and about 40 old workings are now closed. The rock-salt pits now open in the United Kingdom are about twenty-five. So thoroughly free from all moisture have the rock-salt deposits become, that chemical analysis proves that there is absolutely no water at all contained in them, while one or two parts out of every hundred are found in the driest salt made from brine.

A winning, as it is called, for working rock-salt as now sunk, consists of two shafts, placed from 10 to 15 yards apart, with another for pumping the surface water, which is sunk only as deep as the water penetrates. A few of the winding shafts are made wide enough for two ropes,

and are fitted with conductors ; but most of them, at the part which is cased to keep back the fresh water and brine, are only about 3½ feet in diameter, and as the buckets used for drawing with are nearly as wide, they rub against the sides. One of the earliest precautions found requisite in the rock-salt shafts, and afterwards in brine-shafts when they came to be sunk through rock-salt, was the necessity for protecting the rock-salt at the sides from being dissolved by fresh water. Consequently, all shafts going from the surface into rock-salt are turreted or roofed over to keep out rain and snow, and are carefully cased down to a solid foundation, below where surface water penetrates into the ground. In olden times the casing seems to have been made of wood, but recently this has been substituted by iron. Cast-iron tubing for the shaft casing was introduced into the rock-salt mines of Northwich by Mr. Arthur Anderson, senior, about the year 1845. The construction of it is similar to what had long been used in colliery shafts, when it was originally cast in complete cylinders, instead of segments, as introduced by the late Mr. John Buddle. The space behind the cylinders is filled with cement to make all as close as possible. It was supposed that what the wood casing failed to do, would be effectually accomplished by these iron cylinders, and in most instances, when they have been properly secured through the top bed of rock-salt, and properly based at the bottom, this was been effected. However, notwithstanding the greatest care in putting in the castings, fresh water sometimes finds a passage behind them, which, if not discovered and speedily stopped, soon dissolves the rock-salt, so that the wedging ring and cylinders slip, and the shaft collapses. In the present bottom bed workings, the height of rock-salt varies from 15 to 18 feet in Cheshire.

The rock-salt is obtained in masses of considerable size by the usual operation of blasting, and with the aid of mechanical instruments. The drills used for drilling the shot-holes are about 8 feet in length, pointed at each end, and larger in diameter in the middle, for handling, no hammer

being used. In charging the shot, the fine rock-salt made in drilling the hole is put next the powder, and the coarser grained upon that. Safety fuse is very seldom used. The charge is fired by a straw filled with fine powder, which is lighted up by a piece of candle-wick. In firing the shots, the men retire only a few yards, but as the rock-salt does not usually fly far from the shots, and as it will not strike a light either with iron or steel, accidents with powder are much fewer than might be supposed. The winding is now done entirely by steam engines; and iron tramroads are used, though instead of sleepers, the rails are often fixed to pegs let into drill-holes in the rock-salt. The two winding shafts are open to each other in the same chamber at the bottom, without any separation for ventilation, as practised in other mines. The ventilation, notwithstanding the smallness of the shafts, and the want of ventilating power and partitions for sending the air round the workings, is usually good, except for about two months in the hottest part of the summer. At that time the air, it appears, becomes stagnant, and it is said that the miners, when they used to stay in it, got headaches, and their clothes smelled of stale powder smoke. This continues until the cold weather sets in, when the pits again begin to draw freely, and the bad air, as it comes out, may be inhaled in the adjoining lanes. In a general way, the rock-salt strata are remarkably free from carbonic acid gas, and in only one instance at Northwich, and another at Meadow Bank, Winsford, does fire-damp appear to have been met with, and even then in very small quantity. The workmen look healthy; and as a proof of the usual purity and coolness of the air, butcher's meat will keep good in the mine for weeks even in the hottest time in summer.

The system of working the mines appears to have varied very little since the beginning, but the size of the pillars of salt which support the roof and distances between them has been a moot point. Thus "roofing" is a most important matter. An old plan, dated 1786, is in existence showing the top and bottom workings of the Marston mine, as

they existed at that time. The size of the pillars in the top bed is about 6 yards by 4, and in the bottom bed (which was then only being commenced) the shaft pillars were set out from 10 to 12 yards in width. The workings in the bottom bed at the Marston mine are now the most extensive in Cheshire. They are in an oval form, 640 yards long by 820 broad, extending over about 36 statute acres. There are altogether 131 pillars in the mine. The height of each pillar is about 5 yards, and they are of various breadths, lengths, and distances apart. Several are 8 or 9 yards square and 25 yards apart, which seems scarcely sufficient, as some of these are cracked at the corners. The more recent ones are 10 yards square, and 25 yards apart. The thickness of the strata which they have to support from the base to the surface, is about 110 yards. At Mr. Dalway's mine, on the dip of the Duncrue mine, at a depth of 295 yards, which at present is the deepest mine in the United Kingdom, and where 40 feet of rock-salt is being worked, the pillars are 12 yards by 10 at the top, widening to 14 yards by 12 at the bottom. It remains to be proved, how the roof will stand with this height of working and consequent reduced thickness of rock-salt left for the roof. The greatest distance now to be seen of the roof of any rock-salt standing without intermediate support, is the 43 yards in Platt's Hill mine. It would appear that at 110 yards from the surface, with a thickness of 22 yards of rock-salt left above the pillars, a width of 25 yards is found to stand secure, and the proportion of 10 yards by 10, equal to 100 square yards for each pillar left in each area of 35 yards by 35, equal to 1225 square yards (being in the proportion of one of pillar to every 12¼ excavated), is usually found enough to stand without crushing. Pillars 8 yards square and 25 apart, being in proportion of only about one part left for each 17 parts excavated, have been found to stand, where the workings are narrow and the roof derives support from the boundary ribs; but for a large area of workings, this proportion seems inadequate. "Crushing" begins usually

by cracks or breaks at the corners of the pillars. Even in this state the salt generally adheres together, but the roof "creeps" nearer the floor, and the parts of the shafts which are in rock-salt becomes smaller in diameter. In three mines worked about thirty-five years ago, the roof of the bottom bed did not adhere, but fell in. When the working of rock-salt in Cheshire became extended to the bottom bed, and the top bed was discontinued, the pillars in the bottom workings seem to have been made without regard to placing them under those in the top workings.

In the year 1872 the Japanese ambassadors and their suite, accompanied by several leading members of the Salt Chamber of Commerce, paid a visit to the Marston mine. The occasion was most interesting, and the ambassadors, in a document to which was appended their signatures, expressed themselves highly delighted at what they had seen and learnt. Occasionally as many as a thousand persons from Manchester and other manufacturing centres make an excursion to the salt district of Cheshire and descend a mine, thoroughly illuminated for the occasion, long "streets" being fitted up with stalls and refreshment bars. Music is also plentifully supplied, and as many as 400 persons have been known to join in one dance in these crystal halls.

The rock-salt produced in this country is mostly exported to Belgium and other parts of the Continent, the greater portion of it in lumps, but some crushed according to the purposes for which it is required. Germany used to take some rock-salt from England, but her discoveries at home have caused this trade to diminish. Some consumption of ground rock-salt has sprung up of late, for use in the Hargreaves process of making "salt-cake," for which it is better suited than common salt.

The "pits" from which the Brine is obtained for the manufacture of white salt by evaporation are of two kinds, namely, the "springs" which come from the top of the rock-salt, or, as it is locally termed, the "rock-head," and

old rock-salt mines which have become inundated, and in which the water is consequently saturated. It is quite impossible to obtain any list of the ancient brine-pits ever discovered, but of known brine-pits now closed there are over seventy, perhaps even one hundred, in the United Kingdom. The number of those at present worked including "rock-head" brine and old rock-salt pits, is over fifty. In Camden's time, the method of raising the brine was by human labour. He says, "At Northwich there is a deep and plentiful brine-pit, with stairs about it, by which, when the people have drawn the water in their leathern buckets, they ascend half-naked to these troughs and fill them, from whence it is conveyed to the wich-houses." Hand-pumps were afterwards used, and in a few situations which admitted of the assistance of a stream of water, a water-wheel was employed; then horse power and afterwards windmills were introduced; but subsequently steam power superseded all other methods, as the demand for salt increased. The pumping is done through shafts, in the sinking and securing of which the precautions requisite are identical to those required in the rock-salt pits, and having been earlier in point of time, the necessities appear to have been met as they arose. It seems that in sinking to many of the springs, the supply of brine when cut into was so copious, that the sinkers had to escape for their lives, sometimes rising up the shaft amongst the brine without any opportunity being afforded of seeing what was underneath; a fact which accounts for the lateness of the discovery of the rock-salt. In those sinkings where it is still unknown at what depth the brine is likely to be met with, there seems to be no entire remedy against these sudden irruptions. But in the "proved" districts, it is now observed that before reaching the top of the rock-salt, when the rock-head brine flows, there is often a bed of hard marlstone called "the flag" and that for a few feet above it the marl is of a granular structure called "horsebeans." When these indications are observed, and the brine is expected to

be found at a high pressure, the practice is to case the shaft sides carefully down to the flag, to keep the sides secure and prevent surface water from entering. The flag is then either blown through with powder, or bored through with boring rods. The depth from the surface at which the brine-springs are found, the level they take when the stratum which immediately confines them is penetrated, and the abundance of the springs are very various. In Cheshire, in 1808, according to Dr. Holland, the brine at Nantwich was met with about 10 or 12 yards from the surface, and it was difficult to avoid brine in sinkings for fresh water. The brine when reached rose nearly to the surface. At Winsford, it was about 55 to 60 yards before it was met with, and when found it was in great abundance, and it rose to within 12 yards from the surface. At Northwich, it was likewise very abundant, and was found at from 30 to 40 yards. At Winsford at the present time it is met with at the same depth as before, and is still very copious, but the pumping being greatly increased, it now only rises to between 39 and 46 yards from the surface, except on Sundays, when the pumping in many shafts is stopped. The average level is being lowered at the rate of about 1 foot annually; and when it is at the lowest, some of the shafts are dry. At Northwich, the depth where it is now met is about 44 yards below the canal level, and it is kept down by pumping to nearly that depth. At Wheelock, the deepest shaft is 88 yards, and bored 6 yards below that, and the level to which the brine rises is between 30 and 35 yards from the surface. At Middlewich, the deepest pit is now 90 yards. The level which the brine takes in some of the pits varies between 25 and 70 yards from the surface. A daily record has been kept by Mr. H. E. Falk, of the Meadowbank Spring at Winsford, which shows that at the beginning of each week, when most of the pumping has been stopped for some hours, the level is higher. In Staffordshire, the brine at Shirleywich in 1808 appears to have been abundant, but weak; and it is still apparently

the same. The level to which the brine rises, when not kept down by pumping, is 12 yards from the surface. In Worcestershire, at Droitwich, the brine is still copious and strong, and when it is not kept down by pumping, it rises to the surface. The Droitwich Salt Company's shafts are 26 yards 2 feet, and bored to 70 yards. At Stoke Prior, with the present pumping, the brine rises to 65 yards from the surface, and it is not apparently lowered by pumping.

CHAPTER IV.

THE MANUFACTURE OF WHITE SALT FROM BRINE.

THE different kinds of white salt produced from brine are, according to the terms of commerce, first divided into two classes, the "boiled" and the "not boiled." The boiled salt is the "fine" salt we use as a condiment, and is also called "lump" or "stoved lump" salt, the other varieties of "boiled" salt are "superfine stoved;" butter salt, not stoved; and cheese salt, not stoved.

The "not boiled" salt comprises what are called "common" salt, the various fishery salts, and bay salt, our main concern here is with the "fine" salt, or table salt as we may call it.

The manufacture of white salt from brine by the process of evaporation caused by heat, the brine during the process being "agitated," is the chief business of the salt manufacturers in this country, and it is by far the most important of all the methods by which salt is prepared, so far as England is concerned, for not only is the salt thus obtained in a far purer condition than by any other method, but by this method we alone produce in the Cheshire and Worcestershire salt-works, probably as much as a third of the quantity of salt which is consumed in the whole of Europe.

In the time of Edward the Confessor, brine-pits as previously noticed, were wrought at all the *wiches* in Cheshire; but at that period, and for several centuries later, the art of making salt seems to have been very imperfectly understood, and the quantity was inconsiderable. Henry VI., being informed that a new and more productive method had been invented in the Low Countries, invited John de Sheidame, a gentleman of

Zetland, with sixty persons in his company to come and instruct his subjects, promising them protection and encouragement. The result is not stated; but it does not seem to have been successful, for we find the Royal Society, soon after its constitution, directing its attention to the improvement of the art of manufacturing white salt, and publishing several new methods, or rather reports of the methods then in use than suggestions or improvements. The salt made in England was still considered inferior to foreign salt; and that which was manufactured in Cheshire, was confined to the supply of its own consumption and that of a few neighbouring counties. About the commencement of the last century, the attention of the House of Commons was directed to the supposed inferiority of the English manufacture; and a reward was granted to Mr. Lowndes, a Cheshire gentleman, for certain improvements made by him. In 1748, Dr. Brownrigg published a treatise on the '*Art of Making Common Salt.*' Some of the improvements suggested by him were adopted with good effect, and others were engrafted on them. The river Weaver was also made navigable for vessels of considerable burthen from Northwich and Winsford to Liverpool, whereby the facilities for distributing Cheshire salt became greatly increased; the manufacture gradually rose into importance, and salt was not only distributed over the country from this source, but considerable quantities were exported.

The process of evaporating brine is on the whole very simple; and though many attempts have been made to introduce more scientific methods, and numerous patents have from time to time been taken out for this end, the long-established plan of evaporating the water from the brine in large shallow pans by means of heat applied below them is still in vogue; nor does it seem likely that it will be superseded. The brine, on being pumped from the pits, is run into large cisterns, or into reservoirs made sufficiently high for it to flow by gravitation through pipes, as it is required, into the evaporating pans. It is then evaporated upon one general principle. The heat is usually supplied

from coal fires underneath, but sometimes the spare heat from a steam-boiler or the discharged steam from an engine is used; and occasionally there are pipes with steam in them, amongst the brine in the pans. In this way, according to the degrees of heat, the product is small or large grained salt; the simple rule being, that the greater the heat employed and the less time in the pan, the finer the salt made, while the less heat and the longer the time in the pan, the coarser the salt. For what is called "lumped," or "fine-grained" i.e. our ordinary table salt, the brine in the pan is brought to a temperature of 226° F., which is the boiling point for brine. Crystals soon form on the surface, and after skimming about a little, they subside to the bottom. Each crystal appears granular or a little flaky, and is in the form of a small quadrangular, though irregular, pyramid. For "common" salt, as it is commercially called, the temperature is 160° to 170°. The salt thus formed is close in texture and clustered together in larger or smaller pyramids according to the heat applied. For large-grained flaky salt the temperature is 130° to 140°; for large-grained fishing salt 100° to 110°, the slowness of the evaporation allowing the salt to form in cubical crystals, although it appears that they are not perfect cubes. What used to be called "bay-salt," or salt formed by the operation of the air and heat of the sun, seems now to be a thing of the past, so far at least as the salt districts are concerned, although varieties are manufactured to suit the fancy of purchasers. To produce these kinds, foreign matters supposed to be of a harmless kind, such as the white of eggs, calves' and cows feet, ale, flour, resin, butter, alum, etc., have been added to the brine for clarifying and to promote crystallization. The finest salts are drawn from the pans twice or three times in the 24 hours. If allowed to remain too long, the salt crystals would increase in size, and the thick layer of salt on the bottom of the pan would prevent the heat reaching the brine sufficiently to keep it boiling. For "drawing" the salt, it is brought to the side of the pan by

a scraper or rake, and then taken out by a long, flat, perforated iron instrument; for it must be remembered that the brine, as fast as it evaporates, is replaced by more, so that the pan is always nearly full, and thus it is necessary to let the brine drain out of the salt.

Fine salt, as taken wet from the pans, is generally put into "tubs" or moulds which are placed at the edge of the pans, their shape being that of the lumps of salt seen in our shop windows, or hawked about the streets. Eight of these tubs of 14 lb. each make the cwt. At the manufactories it remains in the moulds till the water drains off and it attains consistency enough to be handled, which is the case in about half an hour. It is then turned out and carried into the stove which is at the back of the pan, and is formed by continuing the flues and bricking them over, having the chimney at the far end. The lumps remain till perfectly dried through (known by their giving a clear ringing sound when struck), and then go to a store room above the stove, which receives heat from it. The lumps are then ready either for sending out as stoved lumps for household and other purposes, or for breaking up and filling into sacks for exportation, especially for America, for which country it is often ground finer in mills before being packed. Sometimes the fine salt is not stoved at all, nor yet made into lumps, and is then generally known as butter salt. The largest kind of salt is sometimes allowed nearly a fortnight for formation in the pans. The natural form of the crystals is a perfect cube, unless the formation is interrupted by agitation or strong heat. These cubes exhibit diagonal striæ, and frequently on each side produce squares parallel to the external surface. Every cube is formed of six quadrangular hollow pyramids joined by their apices and external surface, and each of these pyramids is filled up by others, similar, but gradually decreasing. By a due degree of evaporation, it is not a difficult matter to obtain these pyramids distinct and separate, or six of such, either hollow or more or less solid, joined together round a centre. Their bases and

altitudes are in general equal (thus showing the disposition of salt to form a cube), and they are composed of four triangles, each formed of threads, parallel to the base. These threads are a series of small cubes. The crystals of salt, formed by natural evaporation of brine from a pool on the floor of a rock-salt mine, are in cubes about half an inch in size, which lie in various positions; but where salt is formed in a rock-salt mine by evaporation of brine trickling through the air, it is in an effloresecent form. The earthy matter contained in the brine is got rid of in the manufacture by its adhering to the pans in the form of scale, called "pan-scale," or "pan-scratch." There is also the chloride of magnesium, called "bittern," which remains in solution after the chloride of sodium (or common salt) is formed. This is often purposely allowed to flow away by having the floor, or the "hurdles" on which the salt is lifted from the pans, lower than the top of the pan. The pans are of various sizes, the only limitation being, that they must not be too wide for a man to draw out the salt with a ladle. Old records show that they were formerly made, at least in Northwich, of lead, but now commonly of wrought iron, three-eighths of an inch in thickness, and about 50 or 60 feet in length, by 24 or 25 feet in breadth and 2 feet in depth; but some of the new pans are 140 feet by 30 feet by 2 feet. Indeed, they seem to have been gradually increasing in size, to which the only limitation is that above mentioned. Until long after historic times wood was the only fuel used, and the large consumption for which purpose seems to have been early complained of, and it was not until the year 1656 that the substitution of coal at Nantwich is mentioned as a novelty.

The following extract from the Report of 1881 on the Salt Districts by Mr. Dickinson, Inspector of Mines, is interesting: "According to Mr. H. E. Falk there has been no improvement in the manufacture of salt since the days of the Romans, and possibly since the days of the Druids, although 400 patents have been in existence, the only difference being that they employed lead pans 10 square

feet, and now iron pans of 1,500 square feet are used; the principle of evaporation is so perfect that there is no room for improvement. Some of the ancient lead pans were, I find, only half the size stated by Mr. Falk. One such, found at Northwich, shown to me by Mr. Ward, being only 2 feet square in the bottom, and 2 feet 3 inches square at the top."

The manufacture of salt from brine is carried on in France and other countries on much the same principles as it is in this.

CHAPTER V.

ANALYSES:—SEA WATER—SEA SALT—BRINE—WHITE SALT—ROCK SALT.

ANALYSES of substances and of manufactured products are generally speaking only of interest and value to a limited class of readers; but some such technicalities must of necessity be included in this little treatise, though it hardly aims at being more than a popular handbook.

The earliest method of artifically obtaining salt was by the exposure of sea water to the sun and air in shallow pits or reservoirs, the spontaneous evaporation varying much with the general atmospheric conditions. It was at one time practised in this country, for instance at Lymington in Hampshire, at Hayling Island near Portsmouth, at Saltcoats on the Ayrshire coast, and elsewhere, as the remains of old pans still testify. Indeed the evaporation of sea water for the production of salt in "salterns" or "brine-pans" was formerly one of our staple industries. Since the suppression of the duty on salt, and the development of the production in Cheshire and Worcestershire, the sea salt industry has been reduced to one or two establishments round the coast where coal is cheap, as at North Shields, where salt is made by artificial evaporation from strong brine produced by dissolving rock-salt to saturation in sea-water. But the employment of solar heat is common in countries where the climate is more suitable. Hundreds of thousands of tons of salt are annually produced in this way along the West shores of France and Portugal, in the Bay of Cadiz, along the East of Spain and South-East of France, and along the coasts of Italy, Austria, Greece, Spain, Portugal, Turkey, Russia, and India. The manufacture of salt from sea water is in fact

an industry of high importance, employing much labour, and affording large revenues. In some countries sea-water is only evaporated to a certain degree in the shallow pans or reservoirs, and the manufacture is afterwards completed by pouring the brine upon twigs, and sometimes upon burning wood, from which the deposited salt is afterwards collected.

The disuse in this country of the sea water evaporation process cannot be wondered at when we reflect that the amount of salt in sea water is very trifling compared with that in well saturated brine. Though the southern oceans contain more salt than the northern, and some tracts of water more than others, as, for instance, the Atlantic Ocean than the English Channel, speaking in round numbers, salt water contains only a little more than two per cent. of chloride of sodium, as compared with the 25 per cent. contained in good brine; or to put it in another way, a gallon of salt water contains only $\frac{1}{4}$ lb. of salt, while a gallon of brine contains from 2 lb. 4 oz. to 2 lb. 10 oz. Then, too, sea water contains more impurities and much larger quantities of magnesium and potassium salts than brine, and so the production of a pure chloride of sodium involves more complex operations.

Several tables of analyses taken from Spon's '*Encyclopædia of the Industrial Arts*, &c., &c.,' will be found at the end of this chapter. Tables I. and II. refer to sea water and sea salt.

As regards the analysis of brine, it seems to have been long noticed that in Cheshire the Northwich brine contained a trace of iron, and that the earthy salts in it were the same which were held in solution by sea-water, being principally chlorided magnesia and sulphate of lime; the proportions of earthy salts to pure chloride of sodium in sea-water being greater than that which prevailed in the brine. An analysis given by Dr. Holland in 1808, which still holds good, shows that the percentage of chloride of sodium and of earthy salts varied in the following proportions in one pint :—

	Oz.	dr.	Per cent.		Per cent.	
Winsford brine	6	1, or	25·312	of salt, and	2·500	earthy salts.
Leftwich ..	4	15 „	21·250	„	·625	„
Northwich ..	6	1 „	25·312	„	1·562	„
Witton ..	5	7 „	23·125	„	1·562	„
Anderton ..	6	6 „	26·566	„	1·875	„
Wheelock ..	6	0 „	25·000	„	·625	„
Middlewich..	6	2 „	25·625	„	·625	„

Mr. Dickinson, one of Her Majesty's Inspectors of Mines, in his Report of 1881, states that, in his opinion, it is possible that some earthy salts contained in brine may have some connection with the surface drainage, or with the deposits from the use of blasting powder in the rock-salt mines, especially if muddy brine is used. A peculiar odour resembling sewage or stale powder smoke was quite apparent to him when he visited the scene of the great landslip at Northwich in December 1880, and as there can be no question that on such occasions large volumes of surface water find a way into the reservoirs formed by the old mines from which brine is being pumped, sanitary precautions, such as are carefully observed in the working of rock-salt mines, seem equally requisite with respect to the surface water from which such brine is being formed; and that leakage from sewers and foul drains should be avoided.

The brine used in the manufacture of white salt is nearly "*saturated*," i.e. contains as much salt in solution as water is capable of holding. *Fully* saturated brine contains in every 100 lb. about 27 lb. of salt. The best Cheshire brine contains from 25 lb. to 26 lb. per 100 lb. If a brine contains one-fourth of its weight of salt, it is very satisfactory. It is usual amongst manufacturers to estimate the strength of brine by the weight of salt in a gallon; 2 lb. 8 oz. being considered good, and 2 lb. 10 oz. very good. Occasionally it is met with yielding only 2 lb. 4 oz. to the gallon. The importance of strong brine in salt manufacture is evident, when we consider that all the excess of water above saturation point must be evaporated. The excess in cost of making a ton of salt out of 2 lb. 4 oz. brine, as

compared with that out of 2 lb. 8 oz. brine may be stated at 9*d.* per ton ; and consequently if competition should be very severe, this would practically shut out the maker with weak brine from the market.

The following are analyses of Cheshire and Worcestershire brine, extracted from Richardson and Watts, 'Chemistry as applied to Arts and Manufactures.'

Constituents in 100 Parts Brine.	Cheshire.		Worcestershire.	
	Marston.	Wheelock.	Droitwich.	Stoke.
Chloride of sodium	25·222	25·333	22·452	25·492
Chloride of potassium	..	..	..	..
Bromide of sodium	·011	·020	trace	trace
Iodide of sodium	trace	trace	trace	trace
Chloride of magnesium	..	·171	..	..
Sulphate of potash	trace	trace	trace	trace
Sulphate of soda	·146	..	·390	·594
Sulphate of magnesia	..	..	..	..
Sulphate of lime	·391	·418	·387	·261
Carbonate of soda	·036	..	·115	·016
Carbonate of magnesia	·107	·107	·034	·034
Carbonate of manganese	trace	trace	..	..
Carbonate of lime	trace	trace	trace	trace
Phosphate of lime	trace	trace	trace	trace
Phosphate of ferric oxide	trace	trace	trace	trace
Alumina	trace	trace	..	..
Silica	..	..	trace	trace
	25·913	26·049	23·378	26·397

Another Table of direct results of analyses calculated in 100 parts runs thus :

	Droitwich brine.			Stoke brine.		
	I.	II.	Mean.	I.	II.	Mean.
Potassia	..	..	trace	..	..	trace
Soda	12·1501	12·1217	12·1359	13·7804	13·7754	13·7779
Lime	·1581	·1612	·1596	·1102	·1049	·1075
Magnesia	·0167	·0159	·0163	·0187	·0143	·0165
Sesquioxide of iron	..	..	trace	..	..	trace
Chlorine	13·6167	13·6329	13·6248	15·4479	15·4916	15·4697
Bromine	..	..	trace	..	..	trace
Sulphuric acid	·4886	·4876	·4881	·4896	·4880	·4888
Phosphoric acid	..	..	trace	..	..	trace
Silicic acid	..	..	trace	..	..	trace
Residue on direct evaporation	23·4205	23·4205	23·4205	26·4632	26·4866	26·4749

The following Table in round figures will show the relative strength of some English, compared with some foreign brines:

	Per cent.
Northwich	25
Winsford	25
Droitwich	25
Lüneberg	25
Schönebeck	8 to 11
Fredericshall	20
Rottenmünster	26
Château Salins	14
Arc	3 to 8
Dieuze	14
Onondaga	14 to 18
Goderich	26
Moutiers	2

For further analyses of brines, see Table III. at end of chapter.

British white salt holds its own for general purposes against the productions of all countries; but it is still supposed in some quarters that it is inferior to, or rather not so well adapted for the preservation of fish and other animal food, as the salt procured from France, Spain, Portugal, and other warm climates, where it is prepared by the spontaneous evaporation of sea water. Hence large sums of money used to be paid every year to foreign nations for the supply of an article which Great Britain possesses, beyond almost any other country in Europe, the means of drawing from her own internal resources. Some years ago Dr. Henry instituted a careful inquiry into the subject, feeling how important it was to ascertain whether this preference for foreign salt was founded on accurate experience, or was merely a matter of prejudice: and whether any chemical difference could be discovered to explain the superiority of the one to the other. The result was, that the slight difference in chemical composition discovered by him was scarcely sufficient to account for those properties imputed to them. The stoved and fishery salt, for example, though differing in a very trivial degree as to the kind or propor-

tions of their ingredients, are adapted to widely different uses. Thus the large-grained salt is peculiarly fitted for the packing of fish and other provisions. Its suitability for preserving food must therefore depend on some mechanical property; and the only obvious one is the size of the crystals and its degree of compactness and hardness. Quickness of solution, it is well known, is nearly proportional, all other circumstances being equal, to the quantity of surface exposed. And since the surfaces of cubes are as the squares of their sides, it should follow that a salt, whose crystals are of a given magnitude, will dissolve four times more slowly than one whose cubes are only half the size. That kind of salt, then, which possesses most eminently the combined properties of hardness, compactness, and perfection of crystals, will be best adapted to the purpose of packing provisions, because it will remain permanently between the different layers, or will be very gradually dissolved by the fluids that exude, thus furnishing a slow but constant supply of saturated brine. On the other hand, for preparing the pickle, or for striking the meat, which is done by immersion in a saturated solution of salt, the smaller-grained varieties answer equally well or, on account of their greater solubility, even better.

It is a consolation to know in these days, when by some persons "adulteration" is looked upon as a "form of competition" that our common table salt is not tampered with, though any credit attaching to this fact is to be attributed to the cheapness of the article, which it would not pay to adulterate, rather than to any other cause.

The actual purity of the table salt produced by various manufacturers differs somewhat in degree; and those who produce the best should have the credit of it. At the same time, however, unless it be heresy to say so, the impurities in those productions which are found on chemical analysis to be inferior to others, are so slight, that they could hardly affect the health of those who consume them. English table salt may truly be said to be the best and purest

in the world, and it is a fact that foreigners use it when they can get it in preference to any other.

For analysis of white salt, see Tables IV. and V. at end of chapter.

The analyses of Rock-salt show that the transparent portion which is found in small quantities is almost pure chloride of sodium, and has no admixture of earth or earthy salts, or any combination of chloride of lime or magnesia; and that the less transparent portions consisted of chloride of sodium, with a certain proportion of earth or common clay, varying from one to thirty per cent. In each 480 grains it was found, that some of the specimens contained a few grains of sulphate of lime, and that the quantity of pure rock-salt which can be held in solution by a given quantity of water was 6 oz. of salt to 16 oz. of water. The following have been given as the constituent parts of Marston rock-salt:

Chloride of sodium	96·70
Chloride of calcium	·68
Sulphate of lime	·25
Potassium	trace
Magnesium	trace
Water	·63
Insoluble matter	1·74
	100·00

But the constituent parts of rock-salt vary so considerably with the portion of the beds from which it is taken, that it is likely that the percentage of earthy matters found in the different brines will vary with that of the rock-salt from which it is formed. If the same spring were at all times formed from solution of rock-salt of the same purity, some conclusion might be drawn as to the identity of the respective springs; but the constant lowering of the rock-head, by which layer after layer containing different portions of earthy matter are in turn dissolved, preclude much, if any, reliance being placed in this respect; and the same may be said with regard to the strength, which is affected by the quantity of fresh water

finding access to it, either through the sides of the shaft where it is pumped, or through the surface of the earth, and by other circumstances. One of these, as Dr. Holland pointed out, is the extent of the surface of the rock-salt exposed to the water. If the brine be pumped up seldom, it is found to be weaker than it would be if it were drawn up more frequently, as the water on the stratum of rock-salt remains almost at rest till put in motion ; whilst by raising the brine when in this state, the portion of it which is immediately in contact with the rock-salt becomes saturated. Acquiring, however, at the same time a greater degree of specific gravity than it had as pure water, it prevents the water above from sinking down so as to act upon the rock-salt, and the sum of solution is consequently less, than when the pit is frequently worked, and the rock-salt exposed to a more constant action of the water.

For further analyses of Rock-salt see Table VI. at end of this chapter.

TABLE I.—COMPOSITION OF SEA-WATERS.

LOCALITIES.	English Channel.			Atlantic.		Mediterranean.		North Sea.	Caspian Sea.	Black Sea.	Dead Sea.
AUTHORITIES.	Riegel.	Schweitzer.	Laboulaye.	Ure.	Boullion Lagrange et Vogel.	Laurent.	Ann. de Ch. and Ph., Sept., 1849.	Clemm.	H. Rose.	Gobel.	Fleck.
CONSTITUENTS.											
Sodium chloride	2·4632	2·7060	2·50	2·789	2·510	2·722	2·9424	2·484	0·754	1·4019	7·405
Potassium chloride	0·0307	0·0765	..	0·154	..	0·001	0·0505	0·135	..	0·0189	1·690
Magnesium chloride	0·2564	0·3666	0·35	0·233	0·350	0·614	0·3219	0·242	..	0·1305	12·811
Calcium chloride	0·0439	..	..	..	..	..	..	..	..	..	3·536
Magnesium cromide	0·0147	0·0030	..	..	..	..	..	..	..	0·0005	..
Sodium cromide	..	..	..	0·052	..	..	0·0556	..	..	..	0·502
Calcium sulphate	0·1097	0·1406	0·01	0·155	0·015	0·045	0·1357	0·120	..	0·0105	0·121
Magnesium sulphate	0·2146	0·2300	0·58	0·184	0·578	0·702	0·2477	0·206	0·406	0·1470	..
Sodium sulphate	..	..	..	..	..	..	..	..	0·036	..	1·217
Calcium carbonate	0·0176	0·0030	0·02	..	0·020	0·020	0·0114	..	0·018	0·0365	..
Magnesium carbonate	0·0078	..	..	..			..	..	0·440	0·0289	..
Ferric chloride	..	..	..	..	..	..	0·0003	..	..	..	..
Water	96·8414	96·4743	96·54	96·433	96·527	95·896	96·2904	96·813	98·346	98·2253	73·926
Total	100·0000	100·0000	100·00	100·000	100·000	100·000	100·0000	100·000	100·000	100·0000	100·000
Percentage of solid constituents	3·1586	3·5257	3·46	3·567	3·473	4·104	3·7655	3·187	1·654	1·7747	26·065

The percentage of Solid Constituents, and especially of sodium chloride (salt) in the Dead Sea as given in the above Table, is to be specially noticed.

TABLE II.—ANALYSES OF SEA SALTS FROM WELL KNOWN LOCALITIES.

LOCALITY.	St. Ubes.						St. Martin.	From Brittany Marais Salants de l'Ouest.	Island of Oleron.	Salins du Midi.	Cadiz.	St. Felice Trappani.	
AUTHORITY.	Henry.	Berthier.		Karsten.			Henry.	Enquéte sur les Sels.	Henry.	Enquéte sur les Sels.	Watts.	Schrotter and Pohl.	
CONSTITUENTS.													
Sodium chloride .	96·00	95·19	89·19	95·86	92·46	96·50	95·95	87·97	96·40	95·11	92·11	95·91	96·50
Magnesium chloride	0·30	..	..	0·24	0·55	0·32	0·35	1·58	0·20	0·23	..	0·46	0·50
Magnesium sulphate	0·45	1·69	6·20	0·35	0·66	0·25	0·60	0·50	0·45	1·30	0·99	0·40	0·51
Sodium sulphate .	..	..	..	..	..	..	..	..	..	..	..	..	..
Calcium sulphate .	2·35	0·56	0·81	1·30	2·28	0·88	1·90	1·65	1·95	0·91	0·33	0·49	0·45
Water	..	..	0·20	2·10	3·10	1·95	..	7·50	..	2·35	6·30	2·58	2·42
Insoluble matters .	0·90	2·45	3·60	0·15	0·95	0·10	1·20	0·80	1·00	0·10	0·27	0·16	0·07
Loss	..	0·11	..	..	..	..	..	..	..	..	..	..	..
Total . . .	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

TABLE III.—ANALYSES OF BRINES.

AUTHORITY.	A. B. Northcote.				Heine.		Fehling.				Maxwell Lyte.
	Cheshire.		Worcestershire.		Schönebeck.						
LOCALITY.	Marston.	Wenlock.	Droitwich.	Stoke Prior.	Before Gradation.	After Gradation.	Clemenhall.	Sulz.	Friedrichshall. Wurtemburg.	New York Salina from the Carboniferous Formations.	Dax in the South of France.
CONSTITUENTS.											
Sodium chloride . .	25·222	25·333	22·452	25·492	10·404	25·160	25·902	23·473	25·563	13·239	25·273
Magnesium	..	0·171	..	..	0·073	0·630	Traces	..	0·006	0·046	0·030
Calcium	..	..	..	..	..	..	..	..	..	0·083	0·105
Sodium cromide . .	0·011	0·020	Traces	Traces	..	..	..	..	..	..	0·016
Sodium iodide . . .	..	..	..	..	..	..	..	..	..	..	..
Sodium sulphate . .	0·146	..	0·390	0·594	..	..	0·019	..	..	..	..
Potassium	Traces	Traces	Traces	Traces	0·148	0·550	..	..	..	..	..
Magnesium	..	..	..	..	..	0·130	0·610	..	0·002	..	..
Calcium	0·391	0·418	0·387	0·261	0·284	0·170	0·444	0·508	0·437	0·569	0·357
Sodium carbonate . .	0·036	..	0·115	0·016	..	..	..	..	..	..	..
Calcium	..	0·052	..	..	0·049	..	0·019	0·016	0·010	0·014	0·015
Ferric oxide and alumina	..	..	..	..	..	..	..	..	..	0·002	0·012
Silica	..	..	..	..	..	..	..	..	..	..	0·005
Water	..	..	..	..	..	..	73·615	..	73·982	..	..

In this Table the presence of calcium chloride in the Dax brine, of the sodium sulphate in the Worcestershire brine, and the large proportion of potassium sulphate in the Schönebeck brine are specially to be noticed. It is stated by the salt makers of Cheshire that the Worcestershire brine works far more easily than theirs. If such be the case, it may be attributable to this peculiarity of composition.

TABLE IV.—ANALYSES OF COMMERCIAL WHITE SALTS.

AUTHORITIES.	Henry.	Ure.	Watts.		Richardson and Watts.	Fehling.		Maxwell Lyte.	Crace Calvert.	Maxwell Lyte.	Virch.		Heine.
LOCALITY.	Cheshire, Fishery dried at 212° F.	Cheshire Stoved.	Schönebeck.	Stassfurt.	Spencer New York.	Wilhelms-Gluck.	Friedrichshall, Butter Salt.	Dax, Common Salt. France.	Cheshire Agricultural Salt.	Machine Pan Butter Salt from Winsford.	Seelz in Mecklenburg Butter Salt.	Seelz in Mecklenburg Common Salt.	Artern.
CONSTITUENTS.													
Sodium chloride .	98·60	98·250	95·402	97·094	96·29	98·900	97·550	98·500	95·82	95·272	93·79	90·75	96·53
Potassium . . .	..	..	..	..	Trace	..	..	..	..	..	0·89	1·00	..
Calcium . . .	..	0·025	..	0·345	Trace	..	..	0·010	Trace	..	0·26	0·99	..
Magnesium . .	1·10	0·075	0·800	..	0·27	..	..	0·037	..	0·014	0·14	0·60	..
Sodium sulphate .	..	..	..	..	Trace	0·005	..	..	..	..	..	..	0·96
Potassium . . .	..	..	0·414	..	..	..	..	..	..	..	..	..	..
Calcium . . .	1·20	1·550	0·732	0·390	1·39	0·498	0·934	0·452	..	1·900	1·44	0·59	0·64
Magnesium . .	..	..	0·471	0·727	..	..	0·009	..	..	..	..	..	..
Ferric oxide and alumina. . .	..	..	..	0·180									
	..	..	..	..	0·25	..	..	0·090	..	0·160	..	..	..
Insoluble matter .	0·10	..	..	..	0·03	..	..	..	..	0·041	..	..	..
Calcium carbonate	..	..	..	..	..	0·005	0·016	..	..	..	..	..	..
Water	..	..	2·901	1·264	2·20	0·602	1·488	1·890	4·18	2·605	3·88	6·48	1·86
Total . .	101·00	99·890	99·920	100·001	99·23	100·010	99·997	99·889	100·00	99·992	..	..	..

TABLE V.—ANALYSES OF AMERICAN AND ENGLISH SALTS (Porter and Goessman.)

LOCALITY.	AMERICAN.									ENGLISH.			
	Fine Boiled Salts.			Coarse Salts.		Dairy Salt.		Ashton.		Stubbs.	Ashton. Northwich.	Deakin.	Marshall.
	Onondaga.	Hocking Valley.	Mason City.	Onondaga.	Turk's Island.	Onondaga.							
CONSTITUENTS.													
Sodium chloride.	97·12	93·26	95·77	97·31	96·76	97·760	97·672	97·59	97·660	98·0229	97·7598	97·4728	98·4065
Calcium . . .	0·15	1·43	0·61	0·05	..	..	..	0·01	..	..	..	..	..
Magnesium . .	0·13	0·70	0·04	0·05	0·14	..	..	0·03	0·059	0·0124	0·0591	0·0353	..
Sodium sulphate	..	..	..	..	0.64	0·025	0·008	..	..	..	..	..	0·1135
Calcium . . .	1·33	..	..	1·05	1·56	1·295	1·235	1·67	1·381	1·3798	1·2272	1·4413	0·8888
Magnesium . .	..	..	..	..	..	0·066	0·082	..	..	0·0817	0·0769	..	0·0281
Insoluble matter.	..	0·01	0·11	..	..	0·130	0·124	..	..	0·0616	0·0564	0·0490	0·0500
Water . . .	1·27	4·60	3·47	1·54	0·90	0·724	0.879	0·70	0·900	0·5620	0·7880	0·9520	0·4940
Total . .	100·00	100·00	100·00	100·00	100·00	100·000	100·000	100·00	100·000	100·1204	99·9674	100·0757	99·9809

Is to be noted that samples taken fresh from the bins generally contain more water than shown in the analyses, unless the salt has been dried before storage. The water usually amounts to 3–4 per cent. for butter-salt, 5–6 for common salt, and 7–8 for fishery-salts, while some extra fishery-salts contain even more. This water, however, being for the most part merely mechanically held between the crystals, drains away during transit or long storage.

TABLE VI.—COMPOSITION OF ROCK SALTS FROM WELL KNOWN LOCALITIES.

COUNTRY.	GERMANY.								FRANCE.	AUSTRIA.		ENGLAND.	
LOCALITY.	Schwabisch Hall, Wurtemburg.		Merchtes-gaden, Bavaria.	Stassfurt naar Magde-burg.	Château Salins, Lorraine.	Vic in German Lorraine.			Dax.	Hall.	Wieliczka, Galicia.	Mock-salt from Cheshire.	Rock-salt from the Marston mine Northwich
AUTHORITY.	Fehling.		Bischof.	Rammels-burg.	Mathieu de Dombasle.	Berthier.		Cordier.	Maxwell Lyte.	Bischof.	Bischof.	Richard-son and Watts.	Crace Calvert.
CONSTITUENTS.													
Sodium chloride .	99·97	98·81	99·85	94·57	97·05	99·30	97·80	97·45	96·97	99·43	100·00	98·30	96·70
Calcium chloride .	..	0·02	trace	..	..	..	..	..	..	0·25	..	..	0·68
Magnesium chloride	..	trace	0·15	0·97	0·45	..	..	..	0·51	0·12	..	0·05	trace
Potassium chloride .	..	..	..	..	..	..	..	..	trace	..	..	..	trace
Calcium sulphate .	0·02	0·11	..	0·89	1·50	0·50	0·30	0·25	0·23	0·20	..	1·65	0·25
Magnesium sulphate	..	..	..	..	trace	..	..	2·30	..	..	..	..	..
Magnesium carbonate	..	0·15	..	..	..	..	..	..	..	..	..	..	..
Calcium carbonate .	..	0·16	..	..	..	..	..	..	..	..	..	..	..
Ferric chloride . .	..	..	..	..	..	..	..	..	0·01	..	..	..	..
Clay or insoluble matters . . .	0·01	0·80	..	3·35	..	0·20	1·90	..	2·28	..	..	..	1·74
Water or loss . .	..	..	..	0·22	1·00	..	..	..	..	..	..	..	0·63
Total . .	100·00	100·05	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00

CHAPTER VI.

THE SALT TRADE:—STATISTICS OF PRODUCTION IN GREAT BRITAIN — EXPORTS — MANUFACTURERS — PANS—COST OF PRODUCTION—PRICES—PROFITS—PROSPECTS OF TRADE—HEALTH AND WAGES OF OPERATIVES.

THE interests of the Salt Trade in this country are carefully watched over by the Salt Chamber of Commerce, which was formally installed at a numerous meeting of proprietors held at Northwich, on the 30th of August, 1858, its fundamental principles being the formation of an efficient representative body for the extension, general advancement, and protection of the trade. The Chamber, of which all the chief salt proprietors in the kingdom are members, has energetically pursued the objects of its institution, and successfully extended the consumption of salt in markets already established, and brought about the opening of fresh ones. Its yearly reports are replete with useful and interesting information in reference to the progress and requirements of the trade.

It is difficult, now that we get salt at an almost nominal price, to realize the fact that it was once heavily taxed in this country. It seems that salt duties were first exacted in 1702, and renewed in 1732. In 1783 and 1785, Acts of Parliament were passed prohibiting the use of refuse salt by farmers, and from that time until 1819 the law compelled salt manufacturers to throw it into the river in the presence of examiners of the customs, lest it should be used by farmers to defraud the revenue. In 1798 the duty was 5*s.* per bushel, which was subsequently raised to 15*s.*, thus making its cost thirty times greater than that of its manufacture. During the French war, the duty amounted to

over 30*l.* per ton, and, when at its highest, produced a revenue of about 1,500,000*l.* a year; and it is not to be wondered at that such fiscal arrangements led to salt smuggling and a variety of devices for evading the duty. It was reduced in 1823, and finally ceased altogether in 1825, since which date the trade has been entirely free and unrestricted. Between 1823 and 1825 the retail price of salt was between 4*d.* and 5*d.* per lb.: it is now one half-penny. It has been computed that the people of this country require and consume about 16 lbs. of salt per head annually. There are some who still think that an imposition of a duty of from half-a-crown to five shillings per ton, or even more, might be imposed without any adverse effect on the trade, and without its being felt by the consumer. But though a revenue of from a quarter to half a million might thus easily be obtained, such a proceeding would be so contrary to the spirit of modern commercial legislation that it is not likely to be seriously proposed, except under most extraordinary circumstances. Few taxes are really more cruel than those on salt; and yet many governments have from time to time made them to be among the chief sources of revenue.

As with analysis, so with statistics—the latter, like the former, must of necessity be introduced however uninteresting they may be to many readers; and this chapter will have its full share of them.

The periods of great development in the salt trade appear to have been simultaneous with certain causes, such as the repeal of the duty, the increased use of salt in agriculture, smelting, and manufacturing, and especially when it became substituted for seaweed or kelp in the manufacture of soda, and led to the concurrent large increase in that trade. In 1671, when the Weaver was first made navigable to Winsford, only two salt-works were in operation at that place, and those on a very small scale. About the year 1825, probably just after the repeal of the duty, it appears that the whole manufacture of Northwich and Winsford did not exceed 250,000 tons annually.

During the next twenty years the production greatly increased; and in the year 1844 we find that the total salt production of the country including both rock and white salt was about 1,306,224 tons. Passing on to 1875, the returns for that year show that the manufacture of white salt from brine alone in Cheshire and Worcestershire amounted to 1,779,000 tons; and in 1876 to 1,673,540; illustrating as subsequent years have done, that various causes, and especially the export trade, influence the output. Coming nearer to the present date, we have the following return of the production of white salt from brine alone in 1881 :—

		Tons.
Cheshire—	Northwich	500,000
	Winsford	1,000,000
	Middlewich	30,000
	Wheelock and Lawton . . .	100,000
Staffordshire—	Shirleywick and Weston-on-Trent .	4,000
Worcestershire—	Droitwich	115,000
	Stoke Prior	105,000
	Total . .	1,854,000

Averaging the brine to contain 25 per cent. of salt, these 1,800,000 tons of white salt manufactured in 1881, represent 7,200,000 tons of brine, which with the loss and waste averaged at 25 per cent. is equal to 9,000,000 tons of brine used annually.

A small quantity of white salt is manufactured at Duncrue in Ireland from the rock salt dissolved by water into brine; and at some other places rock-salt is used for strenghtening weak brine.

The production of rock-salt, according to the returns under the Metalliferous Mines Regulation Act, under which rock-salt mines are classed is thus stated for ten years to 1881 inclusive;—

		Tons.		Tons.		Tons.
1872. . .	In Cheshire,	137,916	In Ireland,	32,941	Total,	170,857
1873. . .	„	143,597	„	33,751	„	177,348
1874. . .	„	172,855	„	27,951	„	200,806
1875. . .	„	158,044	„	33,075	„	191,119

		Tons.		Tons.		Tons.
1876. . .	In Cheshire,	154,531	In Ireland,	32,310	Total,	186,841
1877. . .	„	179,417	„	28,525	„	207,942
1878. . .	„	152,829	„	30,101	„	182,930
1879. . .	„	159,575	„	30,234	„	189,809
1880. . .	„	167,446	„	31,298	„	198,744
1881. . .	„	166,740	„	30,891	„	197,631

The figures just given representing the total out-put of rock-salt in England and Ireland for the year 1881, added to those representing the production of white salt in England for the same year give us of both kinds of salt a total production of over *Two Million Tons*, the exact figures being 2,051,631. Of this the larger moiety, as will be seen a little further on, was exported, the rest being used in this country as a condiment and for a variety of other purposes.

Various statistics of exports of salt from the United Kingdom show the steady growth of the trade. Looking back only as far as 1844 we find that the export of salt amounted to no more than 673,844 tons. The distribution of this quantity as given in *bushels* (13,476,884), show who were our best customers at that date :—

	Bushels.
Russia	1,823,756
Denmark	462,576
Prussia	1,686,520
Holland	799,802
Belgium	1,041,028
Sweden and Norway	237,594
Germany	301,426
British North American Colonies. .	1,772,799
United States of America . . .	4,664,430
Western Coast of Africa . . .	374,452
New South Wales	125,801
Guernsey, Jersey, &c.. . . .	41,032

The remaining quantity was sent in small shipments to the West Indies, ports in the Mediterranean, River Plate, &c. Taking almost at haphazard three subsequent quinquennial periods, as given in the official Parliamentary Blue Book, we find that in the five years from 1847 to 1851, the exports reached 2,195,605 ; from 1857 to 1861 the total

was 3,201,409 tons; and from 1867 to 1871 the amount was 4,011,659 tons.

The ports from which Cheshire salt is shipped are, Liverpool, Runcorn, and Weston; and to some slight extent Hull, and Grimsby. To Hull and Grimsby the salt is sent by rail; to Liverpool, Runcorn, and Weston Point, by water, either down the River Weaver, which by an Act of Parliament passed in 1721 was made navigable, and is continued navigable from Winsford Bridge to the Mersey; or down the Trent and Mersey, and Bridgwater Canals. The shipping ports for Worcestershire salt are Gloucester and Bristol; but the chief manufacture at Droitwich and Stoke Prior is for the inland trade and home consumption.

Let us now take two or three separate years of more recent date, with the "Statements of White and Rock-Salt shipped from Liverpool, Runcorn, and Weston," the three shipping ports on the Mersey, as published by the "Salt Chamber of Commerce." These will still further show us the increase in the export trade, and also its fluctuations: and by comparing them with the table just above given referring to the year 1844, and with one another we shall be able to see which countries have been our best customers of recent years, and which are so at the present time.

From LIVERPOOL :—	One year to 31st Dec., 1871.
	Tons.
To United States	182,939
„ British North America	94,382
„ West Indies and South America	9,130
„ Africa	22,685
„ East Indies	271,119
„ Australia	9,192
„ Baltic and North of Europe	98,683
„ France and Mediterranean	1,898
„ Coastwise	91,720
„ Holland and Belgium	60,544
Total from Liverpool	842,292
From Runcorn	169,736
„ Weston Dock	43,699
Grand Total	1,055,727

The preceding statement is for 1871. This was the first year in which the exports exceeded 1,000,000 tons; and at no former period had so much salt been manufactured and sold in one year in this country.

In each of the next three years (1872–3–4) the exports from the Mersey fell a little below a million tons, but in 1875 they again reached that amount, and the statement for that year is as follows:—

From LIVERPOOL:—	One year to 31st Dec., 1875.
	Tons.
To United States	212,532
„ British North America	54,807
„ West Indies and South America	4,442
„ Africa	25,507
„ East Indies	311,107
„ Australia	24,918
„ Baltic and North Europe	101,989
„ France and Mediterranean	889
„ Coastwise	72,268
„ Holland and Belgium	62,917
Total from Liverpool	871,376
From Runcorn	71,018
„ Weston Dock	90,093
Grand Total	1,032,487

The exports then again fell below a million tons till we get to the year 1879, when the figures stood at 1,086,850 tons. In 1880 they rose to 1,201,496 tons. For the three last years up to 31st December last, the table stands as given on page 17.

From these tables it will be seen that the United States and India have for many years been the best customers of our salt trade, and France our worst, the import of English salt into the last mentioned country being still practically prohibitory, though there have been many negotiations between the Governments of the two countries in reference to a modification of fiscal arrangements as regards this commodity.

A whole volume might be written on the subject of salt

From LIVERPOOL :—	One year to 31st Dec., 1881.	One year to 31st Dec., 1882.	One year to 31st Dec., 1883.
	Tons.	Tons.	Tons.
To United States	228,891	223,602	239,459
,, British North America . . .	80,784	81,716	99,352
,, West Indies and South America.	15,556	23,935	25,413
,, Africa	25,181	34,287	36,896
,, East Indies	324,109	274,866	316,327
,, Australia	23,872	17,232	10,860
,, Baltic and North Europe. . .	100,957	116,509	107,978
,, France and Mediterranean . .	1,187	5,001	2,803
,, Coastwise	41,653	32,462	46,753
,, Holland and Belgium. . . .	67,780	67,334	72,353
Total from Liverpool .	909,970	876,962	958,194
From Runcorn	148,122	146,716	141,021
,, Weston Dock	85,545	68,147	87,954
Grand total	1,143,637	1,091,825	1,187,169

in India, and yet not exhaust the subject. Till within the last twenty years, salt making and selling was entirely a Government monopoly over the whole dependency, but the salt produced, whether from washing salt soil, from the mines in the salt range in the Punjaub, or from evaporation of sea-water on the coast, was, and is still, of an inferior character, more or less dirty in colour, and containing from 10 to 12 per cent. of impurities. Various changes in the fiscal regulations have been made from time to time, but the monopoly has always been productive of great jobbery and a variety of abuses, in consequence of the salt passing through so many hands. Six million pounds sterling annually was a large revenue for the Government to secure from salt, but this was obtained at the expense of the natives, who in some districts spent as much as one-sixth of their annual earnings upon what is absolutely a necessary of life to a people whose food is peculiarly insipid, and who use little fish or animal diet. As long ago as 1831–32 a Parliamentary Committee stated that the price of salt in some districts of India was about 288 per cent. above the original cost and charges. It also expressed an opinion that the Bengal Presidency might obtain a cheaper supply by importation from the coast of Coromandel, Ceylon, and

elsewhere, and even from Great Britain, than by the existing system of home manufacture, and recommended that the Government should contract for the delivery of salt, by advertisement, into the public warehouses of the port of Calcutta, at a certain price per ton, and that in the interest of the natives the home manufacture should be gradually diminished. It was not, however, till 1863, through the instrumentality of Sir Charles Wood, that the Government monopoly was abolished in the Bengal Presidency, and salt admitted *into bond* at Calcutta, with a customs duty of about £6 per ton, payable on its being taken out.

Several alterations in the duties have been made since the above date. They were raised about the time of the Mutiny in 1857. In 1878 they were lowered; and again in March 1883 they were lowered throughout British India, and arrangements made with the Native States, under British protection, for the purchase and control of their salt works; and the duties were equalised in the different provinces. This all-important equalisation of the duties on salt in India, after years of patient negotiation, must eventually prove a great boon to the trade, by increasing the consumption of English salt in that country. As yet there has been hardly time to test the full benefit of this great measure; but that it will lead to a generally increased consumption of English salt, particularly of manufactured English salt, is unquestionable, as soon as the latter finds its way into distant provinces. It is almost impossible to over-estimate the benefit conferred upon the natives by the reduction of the price of salt, and recent fiscal regulations, it being calculated that the consumption is reckoned at about 13 lbs. per head of a population over 200 millions. The average price they now pay for their salt may be put in a very rough way at about 1*d.* per lb., which is only double the price of the commodity in this country. At the same time it is satisfactory to know that the public revenue has not suffered, and, after land, salt still yields the largest contribution to the Indian Exchequer, the

figures it represented in 1882 being close upon seven millions sterling. While this Handbook was passing through the press, the Under-Secretary of State for India was asked whether, considering the alarm throughout Europe at the spread of Asiatic cholera, and in view of the fact that there was so often a deficiency of salt found in the blood of persons dying from this disease, and that vast numbers of the natives of India were not able to procure a sufficiency of salt, Her Majesty's Government would at once abolish the salt tax in India. The answer given by Mr. J. Cross was to the effect that it was not a fact that a vast number of the people were unable to obtain a sufficient quantity of salt. He was not aware that this question had any relation to cholera in India. A further question was then put, whether it was the case that since 1882 the Excise regulations respecting the salt monopoly had been made more strict in the Madras Presidency; and whether the Government intended to give the native population the inestimable boon of further reductions in the salt rates. The answer was in the negative.

Readers who are specially interested in this question of the Indian salt supply, and our salt trade with that part of our Empire, cannot do better than obtain a pamphlet entitled "Salt in India," published at Northwich in 1880, and presented to the Salt Chamber of Commerce. It is written by Mr. H. E. Falk, one of the largest salt manufacturers in Cheshire, and the leading authority on all matters connected with the salt trade. It is mainly through his exertions that the equalisation of the salt duties in India has been brought about. The annual reports also of the Salt Chamber of Commerce for some years past have contained much interesting and valuable information on this subject.

North America is a good customer to our salt manufacturers, partly because its home salt supply is derived from its comparatively weak brine springs, and partly because of the cost of fuel for manufacturing salt from them. In fact, we can make salt of better quality and

more cheaply than at present is possible on the other side of the Atlantic. After a long contention between the advocates of free trade and the upholders of the salt monopoly in the United States, the former succeeded, in 1872, in getting the import duties on salt reduced to 8 cents for "bulk" and 12 cents per 100 lb. for "sack" salt, and the effect of this reduction was soon seen. American shipments are almost entirely made at Liverpool, as American vessels which bring over cotton thus get freights back. The reduction of the duties therefore by the States has not only been to the advantage of the Cheshire manufacturers, but it has materially benefited both English and American shipping. A further reduction of the duties would still further benefit both our manufacturers and their customers. On this subject Mr. H. E. Falk, in a pamphlet he wrote on "Salt in North America" in 1877, after a visit to that country in the previous year, says:—"I am happy to have to report so little cause for alarm on our part. America is growing with giant strides, and the consumption of salt for manifold purposes is increasing amazingly. But, like all civilized communities, it becomes more and more fastidious about the quality of all the articles it consumes, and more especially the edible portion of them. Therefore, if Cheshire salt is to hold its place in the American market, it must be sent out and arrive there clear and clean as it comes from the pans that produce it. I am clearly of opinion that the whole of the American salt works are simply fit to supply local demands, were they to be left, which they undoubtedly will be some day, without the high protective duty. The great consumers of the West will not submit, in a free country like America, to be taxed heavily for the purpose of propping up an artificial industry, which labours under the greatest disadvantages in the principal supply of the article it has to manipulate. The whole of the salt districts I have visited would not be looked at in England for a supply of brine. The weakness and impurity of this first essential for salt manufacture make it unfit for free-trade manufacture. The only

profitably worked salt districts in England are those belonging to the new or Tertiary geological period, as they supply the pure brines. Those of the American district all belong to an older period, and consequently, besides being costly to get at, are impure and weak. The splendid system of American railways will contribute more than any other circumstance to an early revision of the tariff, as free trade is as the life's blood to these great arteries of internal communication."

The increase in the salt trade may also be partly gathered from the comparison of the number of "pans" at work in different years, which the following table will show :—

District.	1867	1868	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880	1881	1882	1883
Winsford. .	459	489	503	517	523	541	554	567	595	616	624	612	607	629	638	631	631
Northwich .	293	316	343	351	355	388	393	400	434	462	478	484	485	453	459	461	465
Middlewich .	..	..	..	13	13	13	13	11	11	12	12	13	13	13	13	13	13
Sandbach .	..	..	..	60	60	61	62	67	67	67	67	68	68	69	69	68	68
Droitwich Dis.	..	..	..	137	141	145	148	153	154	154	151	151	151	151	151	144	135

As on an average a salt-pan will make about 1000 tons per annum, the business of a firm can be judged by the number of pans which they have at work.

There are over fifty salt works in the Cheshire district owned either by private firms or public companies. In the Worcestershire district the two great firms are those of Mr. John Corbett, M.P., at Stoke Prior, and of the Droitwich Salt Co. at Droitwich. Beds of rock-salt underlie this district, and the brine-springs from which the salt is made are simply springs of water saturated, or very nearly so, with salt from the rock. At Droitwich, which is the original seat of the salt manufacture, these springs used to rise to the surface, the name of the settlement in Roman times, "*Salinæ*," pointing to this fact. The subterranean resources, however, having been drawn upon through a long series of years, the brine has become more

difficult to obtain, and at present is reached by shafts (lined with iron cylinders to prevent the entry of fresh water) from 80 feet to 100 feet deep, in which it rises to within about 30 feet of the surface. The salt works of Mr. Corbett are among the largest in England, and are certainly the most complete of their kind, covering an area of more than 22 acres. Here the brine is pumped from wells varying from 300 feet to 800 feet deep, an increase of depth, as compared with Droitwich, which is rather to be attributed to the conformation of the surface of the ground than to any difference in the position of the salt-bearing strata. The full weekly production at the two establishments would be over 6000 tons, if always at full work; and the three kinds of salt chiefly made are "butter" "table," and "broad" salt, the latter being largely used for agricultural purposes. Mr. Corbett is the patentee of a new mode of preparing salt of a superior fineness and hardness, which consists in the use of a covered pan, inside of which a number of rakes are made to revolve by steam-power. The agitation of the brine and the greater heat caused by the retention of the steam combine to produce a more rapid deposition of the salt, the crystals of which are consequently very fine and hard. Mr. Corbett has also provided model cottages at a moderate rent for his workpeople, and supplied them with schools, a dispensary, and buildings for religious services, and thus made his works at Stoke Prior quite a model manufacturing establishment.

Maldon in Essex has been the seat of a salt manufactory for a great number of years; and there the Maldon Crystal Salt Company turn out many tons per week of a salt from sea-water. It is prepared with the greatest care, and is of absolute purity. It is produced and sold in large crystals, which some persons prefer to small-grained salt; and in this form is highly esteemed by many connoisseurs, who also appreciate its pretty appearance on the table in tasteful salt-cellars. Crystal salt is sometimes seen of a pink colour, which is probably given to it by cochineal; but this is not a production of the Maldon Company. The colouring seems

to be added simply to increase its attractiveness on the table.

The price of salt depends mainly on the cost of fuel, and partly on that of iron, which is used for the pans and for other parts of the "plant," and soon perishes from the action of the salt, while at the same time, as in the case of other articles, the price fluctuates according to supply and demand. "Common" salt, which is the cheapest made, forms the standard of price, all the other qualities being regulated by it. For many years, as coal remained pretty steady, salt fluctuated but little. From 1845 to 1850, the average price of common salt was *7s. 6d.* per ton at the works. It fell as low as *5s. 3d.*, and then advanced to *12s.*, but for short periods. From 1850 to 1860, the price was much the same as in the previous five years. When the American war commenced, prices fell, and during the war averaged about *4s. 3d.* at the works. Some lots were sold as low as *3s. 9d.*, the lowest price ever known. In 1865 the price advanced, and since that period it has been from *6s.* upwards. In 1872 it reached *20s.* In 1873 it commenced at *12s.*, but soon rose to *15s.* In 1874 it fell from *12s.* to *8s.*; in 1875 it kept nearly steady at about *9s.*; in 1876 the price fluctuated from *8s.* down to *5s.*; in 1877 it even fell to *4s.*, rising again to *7s.*; in 1878 it was at *7s.*, and fell to *5s. 6d.*; in 1879 it again went as low as *4s. 6d.*, running on into 1880 through *4s. 6d.*, *4s. 9d.*, to *6s. 6d.*, and back to *6s.* In 1881 the works' price was rated at Liverpool at *5s. 6d.* for common salt. Last year it may be put at *4s.* to *4s. 6d.*

According to evidence given before a recent Parliamentary Commission, the cost price of manufacturing common salt in the Winsford and Northwich district is about as follows:—Brine, *6d.* a ton; labour, *10d.*–*1s.*; coal (slack), *3s.*; rent, interest on capital, &c., *1s.*; total, *5s. 4d.*–*5s. 6d.* a ton; but these are subject to many important variations. To the above costs are to be added those of carriage to various ports of shipment.

In addition to its use as a condiment and an antiseptic, the demand for salt for a variety of other purposes affects

its price and the profit of the manufacturer. Salt is extensively used in agriculture, an ancient practice in vogue in Palestine and China more than 2000 years ago; and it is possible that there will be a still greater demand for it to mix with ensilage as the use of silos becomes more general. Salt is also largely employed in the manufacture of the various salts of soda, especially the carbonate. The soda used in soap-making and for other purposes was formerly obtained by burning marine plants, such as *Salsola Soda* and *Salicornia herbacea*, on the coasts of the Mediterranean and other warm climates, the ash obtained being called *barilla;* while on some parts of the coasts of Ireland and Scotland an inferior article named "kelp" was produced by burning the *Fucus vesiculosus* and other species of Fuci. The repeal of the duty on salt almost entirely superseded the manufacture of "kelp," the supply of soda being now furnished by the decomposition of common salt by a process invented by a French chemist, Leblanc, at the close of the last century. Salt may be said to have made the alkali trade of this country. Salt is also employed in the preparation of hydrochloric acid; in the glazing of stoneware; in the manufacture of soap, which it hardens; and in that of glass, to which it gives whiteness and clearness. It is largely used in metal-refining works, as it preserves the surfaces of melted metal from calcination by defending them from the air. It is employed with advantage in some assays, also as a mordant, and for improving certain colours; and in dyeing, bleaching, and calico-printing works. In fact it enters more or less into a very large number of art processes and manufactures in this country; and consequently on the condition of trade in a variety of branches the prosperity of the salt industry greatly depends.

On the whole, however, the salt trade, important though it be, is one which does not hold out any very strong inducements for capitalists to enter. It is somewhat precarious in its nature, and easily affected by external circumstances. It is mostly in private hands, by which it

seems better managed than by companies, few of which have paid dividends of an attractive character. Here and there, fortunes have been made; but fortunes have also been lost, in experiments and failures in "pricking," *i.e.* finding brine. It must be remembered, too, that in several localities of the salt districts symptoms have long been shown of a failure in the brine supply. Many shrewd capitalists, however, outside the trade, think that more might be made of it. In 1872, for instance, several leading capitalists of Manchester invited the salt trade to a conference, having for its object the absorption of the whole salt trade into a Limited Company, which should buy up all existing salt-works, and secure, as far as possible, all salt lands in the neighbourhood of the River Weaver and the railways. The whole question was discussed between the parties interested at Northwich, but no tangible result was arrived at, and the matter seems to have dropped. The movement, however, did some good, by showing salt proprietors the real value of their investments, and also that, if they continue united for their common good and refuse to be the sport of jobbers and shippers, who have so long exercised an undue influence over the trade, they can secure for themselves that legitimate return for their capital to which they are fairly entitled.

As regards the health of the operatives engaged in the salt manufacture, though many of them work in a very high degree of temperature during the greater part of the day, it is on the whole very good. An atmosphere impregnated with salt is, as a matter of fact, a preservative against colds, rheumatism, neuralgia, and other ailments caused by exposure to cold and damp, which are so common among working men. Salt "boilers" or "makers," as they are called, generally live to a good old age, but unfortunately the very nature of their work is provocative of thirst, and leads to some intemperance among them. In Cheshire, as in Worcestershire, they are paid at the rate of so much per ton; and when at full work a man can earn from 30*s.* to 35*s.* per week for making fine salt, *i.e.*

after paying his "assistants," who help him in "drawing," drying, and warehousing it. For "firing" the pans, he receives something extra. A salt maker employing an average family to assist him, can make about 35 tons of fine salt in a week. The employers deal only with the salt maker, who is thus a contractor on a small scale. Women are not generally employed in Cheshire; and at the Stoke Prior Works, in Worcestershire, Mr. Corbett some time ago succeeded, though after a great deal of trouble, in abolishing female labour altogether. Wages in Worcestershire, it is said, compare favourably with those in Cheshire, as in the former employment is constant, while in the latter the workmen sometimes lose a good deal of time. It should be remembered, as bearing on the question of wages, that salt making is little more than drawing salt from the pans, and is therefore to a very great extent only unskilled labour.

CHAPTER VII.

LANDSLIPS, AND SUBSIDENCES OF THE SOIL IN THE SALT DISTRICTS OF CHESHIRE AND WORCESTERSHIRE.

AN interesting though somewhat painful circumstance connected with the salt districts of Cheshire is the constant recurrence of landslips and the gradual subsidence of land in many parts. The continual flow of the fresh water over the strata of rock-salt, thereby gradually diminishing the deposits, and the pumping it up in the form of brine, has for ages been gradually thinning the crust of the earth above, and so creating large hollows beneath the surface. This, and the falling in from time to time of the roofs of rock-salt mines, has caused landslips and subsidences of earth, of a more or less serious nature, at different periods in the salt districts, particularly in Cheshire. These displacements having of late years presented more alarming aspects, the Government thought well to instruct Mr. Joseph Dickinson, one of the Inspectors of Mines, to investigate the whole matter. His first Report was published in 1873, and a most interesting one it is, and well worth perusal even by those who are not personally connected with salt manufacture. Mr. Dickinson is not a mere prosaic inspector, but an antiquarian ; and informs us that landslips and subsidences began some centuries ago. The first landslip in the salt districts which seems to be recorded in history took place in the year 1533, near Combermere Abbey, concerning which it is said in 'Leyland's Itinerary' that "part of a hill, with trees upon it, suddenly sank down and was covered with salt water, of which the abbot being informed, caused it to be wrought ; but the proprietors of the Wiches compounding with him, he left off working."

The second landslip was on the 8th of July, 1659, and is recorded in Ormerod's 'History of Cheshire,' as happening at a place now called Barnelfall, near Bickley.

All round Northwich these landslips and subsidences, some dating back to remote times, may be witnessed, the ground in some places being torn up into furrows, and still visibly on the move, in one place a depression of about 70 feet having occurred within the memory of man. In the valley between what was once Witton Mill and the River Weaver, where there was a canal, and Witton Brook, a large mere or lake is now being formed, the progress of which can be traced from time to time by referring to maps of the district made at different periods. In this part the water has made its way into different mines, and a great portion of this particular district has become something like a cullender, and baffles the art of man in keeping up the roads and means of communication on the surface. At Winsford, a few miles from Northwich, the development of the phenomena has been sudden and surprising. For about 2½ miles in length by 1 mile in breadth the surface is visibly sinking. The canal near the front of the landslip has already gone down 10 feet. At the Winsford end the subsidence is backing down to the town. The Winsford docks have already gone down about 10 feet, and the bridge over the Weaver has again been raised to give height for the passage of boats. In the intermediate parts in the valley of the Weaver a large mere called "The Flashes" is being formed, whilst on the high ground the land is being torn into furrows and holes. The Ordnance Map of 1842 shows the extent then covered with water. The area is now more than doubled. Numerous other landslips and subsidences certainly give the impression that the salt districts are anything but pleasant ones to live in, as the inhabitants can hardly be said to have "fixed residences," while nature, animate and inanimate, seems more or less generally incrusted with a mixture of white from the salt, and black from the coal used in its manufacture.

The buildings in all towns and villages in the immediate vicinity of salt works suffer more or less from the subsidence of the land ; but in no place is this more curiously and painfully illustrated than in Northwich. This little Cheshire town was visited by the writer of this Handbook a few years ago, when he was gathering information in reference to salt manufacture, and a very vivid impression was left upon him. Northwich has a somewhat doleful aspect, almost everything being out of the perpendicular or horizontal, as the case may be. A sober visitor, as he walks along the streets, might almost fancy he was suffering from some ocular delusion. It would only be to a person in a state of inebriety that the place would look natural. Indeed, the houses and buildings themselves look inebriated, and tumbling about like a set of drunken men. One is leaning forward, and threatens to tumble into the street, while another is reeling backwards, and suggests the possibility of its eventually falling into the back garden. Then you may see two houses divided by a narrow passage, which have subsided sideways towards each other, and both are apparently kept from falling by the mutual support they receive from the meeting of each other's roofs ; or two others, which once were in amicable and perpendicular relation to each other, apparently endeavouring in a hostile spirit to make the gap between them as wide as possible. In more than one place a main street has become widened by some feet, the lines of houses having gradually and modestly withdrawn themselves some distance from the road and pathway. In one instance of this kind the proprietor of the newly-obtained frontage asked the Local Board for the value of the land, which they claimed under the circumstances as town property. The request was refused ; but it is a nice point, if ever it comes to trial. Houses are constantly getting into such a state, that it is necessary to pull down and rebuild them, after "washers," "shaps," "face plates," "bolts," and other expedients, together with shoring up, have been resorted to for years. As an instance of the rapidity with which a building will

become untenable may be mentioned the Town Hall, which had to be abandoned not many years after it was built. Again, houses which have been built on rigid wooden frames, and, like Swiss chalets, with much wooden framework in their construction, have frequently to be raised up bodily two yards and more by means of jacks. Experience has recently taught the Northwichians that the best plan is to build on wooden sills and with wooden framework. With such constant work of building up and pulling down, repairing and strengthening, Northwich must be a very Elysium of builders. The most notable instance of subsidence is a cottage which in the memory of many living persons has sunk so deep into the earth, that what were once the bed-rooms on the first-floor are now the sitting-rooms on the ground-floor, the wall between the windows having been knocked through to make a new door. The top of the old door and windows of the ground-floor are now just visible above the ground, and probably the old sitting-rooms are now used for cellars. It sometimes happens that the subsidence of the earth takes place very rapidly, and buildings have been engulphed with hardly a minute's notice. A few years ago a steam-engine and eight men were swallowed up, and scarcely a trace of the accident left, with the exception of the depressed earth. A cottage and some women were similarly entombed, and where the building stood there is now a pond, in which at the time of the writer's visit ducks were happily sailing about. Cracks also in the earth and in the walls of buildings will very suddenly present themselves. People in bed often hear the bricks "grumping," and instances have been known of a light being blown out by the wind entering at a sudden crack in the walls. Cracks also will sometimes open in gardens and in the streets of from 12 to 20 feet deep, so that it is actually dangerous to walk in a dark place by night, risking, as one would, a sprained ankle or some worse accident. It is no exaggeration to say that, with the exception of the case of newly-built houses, there is hardly a level floor in the whole of the town.

And yet, notwithstanding this highly uncomfortable state of things, the good people of Northwich are something more than moderately happy and contented. Accidents involving a sacrifice of life so rarely happen, that they do not make themselves miserable on this score. They seem to trouble themselves as little about what is going on below them through the action of water as do the dwellers round Vesuvius about subterranean fires (*suppositi cineri doloso*) over which they have their being. Indeed Northwich, notwithstanding its zigzag appearance, is a well-to-do little town. A good deal of money is made in it, and consequently a good deal spent in it. Property in land and houses, notwithstanding the tendency of each to disappear, is of considerable value, and is dealt in with as much apparent confidence as if it rested on a solid bed of Kentish chalk, or on the thick granite strata of Dartmoor: and the dwellers in the salt districts generally are probably not nearly so nervous as to the instability of their soil, as are just now the good people of Essex in the neighbourhood of Colchester, who have not yet recovered from the effects of the recent earthquake in East Anglia. It certainly is reassuring to the present inhabitants of Northwich to know that their town existed in some form or other in the time of the ancient Britons, by whom it was called *Hellath* or *Hellu Du*, the "Black Salt Town;" and that, despite all the subsidences, crackings, and changing aspects of nature, it is likely to continue to exist in some form or other for many generations to come, and supply us at home, and a great part of the world besides, with the indispensable article of salt.

But these disastrous and even alarming displacements of the soil are still going on, as may be gathered from the further Report of Mr. Dickinson in 1881, and from accounts which have come to hand since the beginning of the present year. In the neighbourhood of Winsford some of the main thoroughfares have sunk a considerable depth, and at the present time are being filled up and repaired, and means adopted for the preservation of adjoining property. Many

of the old dwellings of the town have completely disappeared in the ground, and other houses have been erected over them. There is a space left vacant in the market-place, where a whole row of houses have entirely sunk beneath the surface. Close to the Market Hall there are buildings which have subsided to half their original height, and rooms that were once bedrooms are now shops on the line with the street. In one case a draper has his shop over his old bedroom. Since the Royal Oak Hotel was built eight years ago, it has had to be lifted twice by hydraulic jacks. The Town Hall had so much sunk, that a year or two ago it had to be raised 8 feet. A great deal of the subsidence has occurred in the neighbourhood of Christ Church. In fact the church is on anything but a "sure foundation." Four years ago the structure was condemned, and it was taken down and replaced with a building of strong timber and brickwork. Notwithstanding the precautions, this, too, soon began to be affected by the subsidences, and during the past two or three years a portion of it has had to be raised no less than seven times, to preserve its equilibrium. The old Market Hall is now beneath the surface of the ground, and upon its place is a new one. The history of the old building is unique. On its erection a flight of steps had to be ascended to gain the entrance. As the subsidence continued, the steps gradually disappeared, and in a few years entrance could only be obtained by a descent. It went on sinking, until it completely disappeared beneath the surface, having sunk altogether no less than 27 feet. On account of the continual subsidences the Weaver school premises are sinking, and the authorities are expected shortly to condemn them as unsafe. Breakages of mains, pipes, &c., caused by the sinking of the land, are constantly going on, causing much inconvenience and very considerable expense.

Indeed, such as been the damage done to land and buildings in the Salt District of Cheshire during the last few years, that it is not surprising that a large number of owners, who did not directly receive any benefit from the

salt manufactures, should come to gradually feel it an injustice that damage should be done to their property without some compensation. But all through the agitation, which assumed a definite form some years ago, the great difficulty was to suggest any equitable basis on which compensation should be made. Eventually a private Bill was promoted by certain property owners in the Northwich and Winsford districts in the session of Parliament 1881, entitled "A Bill to make Provision of the Assessment, Levy, and Application of Compensation for Damage by Subsidence of Land in the Salt Districts of Cheshire, and for other purposes." The Preamble set forth "That great quantities of brine for the manufacture of salt are annually raised by pumping from the beds of rock-salt. That such beds form the natural support of the superincumbent strata, and of the surface of the ground. That by the pumping the beds of rock-salt are continually being dissolved, and the natural support withdrawn with great injury to the surface and property. That the brine so pumped is for personal profit, and for purposes of sale and manufacture, and is not exclusively derived from beds of salt owned by the pumpers, but is frequently in great part derived from what belongs to others who receive no payment. That from the difficulty of proving whence the brine pumped at any particular pit is drawn, or by what pump the damage is done, it is impracticable to obtain any remedy by legal proceedings. And that it is just and expedient that provision should be made whereby compensation could be obtained for such damage." It was further proposed that a sum not exceeding 3*d.* for every ton of salt in brine raised or obtained in the districts, it being considered that this would suffice, and would not materially affect this salt trade or expose it unduly to competition, and that a Board representing various interests should be constituted with powers to ascertain the amount required, raise the money and distribute it and act generally. The Bill was strongly opposed by the salt manufacturers, and the whole case was elaborately argued by eminent Parliamentary counsel before

a Committee of the House of Commons, which eventually announced the unanimous opinion that the "Preamble was not proved."

Thus the matter is left as it was, and for the present at least the salt trade is saved from an interference which might seriously cripple if not ultimately ruin an important industry. Unless some definite legislation to the contrary is effected, brine will continue to be treated under the same rules as water. Natural flows of water on the surface may be used as they pass, but not fouled, nor turned into another shedding; and below ground, where water is not in some defined channel, it belongs to the person in whose well, shaft, or working it is found. Any number of neighbours' wells may be drained into a properly worked mine with impunity, "the miner getting what he does not want, and the neighbours losing what they greatly prize." Brine is claimed in the same way, and is taken to belong to the person in whose digged well, shaft, or working it is found, no matter where it comes from. This is in accordance with the firmly established principles of Common Law concerning the flow of subterranean liquid; and any modifications of them to meet this particular case would be generally considered an injustice to the salt trade, and likely to injuriously affect the consumers of salt. Mr. Dickinson gives in his Report of 1881 a full history of this complicated case, arranging the *pros* and *cons* in a most interesting and impartial manner, and concludes with the following sentence:—"The failure to obtain a settlement of the question may be regretted, but, considering all the grounds upon which the case was combated, no one can reasonably quarrel with the decision of the Committee. It may have to end as it stands, or possibly upon some equitable basis an arrangement may be effected."

Taking the returns of salt production in 1881, the following interesting but somewhat alarming calculation has been made by Mr. Dickinson in his Report of 1881. "The admitted annual production of 1,600,000 tons of white salt in Cheshire, and of about 220,000 in Worcestershire, and

say 4000 in Staffordshire, beside last year's production of 166,740 tons of rock-salt in Cheshire, and 30,891 tons in Ireland, is drawn from the ground. The production of white salt from brine in Cheshire alone, accompanied with say 25 per cent. of waste in production, working and transit, and averaging each cubic yard of rock-salt dissolved to weigh 33 cwt., represents 1,212,000 cubic yards of rock-salt, or about 250 statute acres one yard in thickness, annually pumped out of the ground; the rock-salt produced representing 21 acres or more.

Subsidences are also taking place in the Worcestershire Salt District, and the town of Droitwich has already suffered to some extent as Northwich has, but it would hardly be within the scope of this Handbook to enter further into the matter. It has been introduced as likely to be of interest to general readers, and as an illustration of the consequences involved by the consumption of such a simple article as common salt.

CHAPTER VIII.

SALT-LORE.

HAVING now briefly considered salt as a condiment, the sources of its supply, and its manufacture for our ordinary use, it seems but appropriate to add some remarks on what may be called its lore. On this a volume of no small dimensions might be written without exhausting the subject, as in almost all nations from the earliest times salt has been associated with a variety of religious, social, and other customs, and many superstitions ; while its symbolical significance has been almost coexistent with its practical use.

Salt-lore would naturally begin to accumulate with its earliest use, which, if the suggestions made in Chapter I. be correct, may be taken to be coeval with man. The idea of holiness was attached to salt from the very earliest time, as may be gathered from several ancient mythologies. The Germans called salt the special "gift of God," and there was an old belief among them that where salt water was, there heaven was near, and that prayers were better answered when offered near salt. The Old Testament contains many mentions of salt, which refer to ancient customs and associations connected with it. Thus its use is emphatically enjoined in the Levitical Law :—"Every oblation of thy meat offering shalt thou season with salt ; neither shalt thou suffer the salt of the covenant of thy God to be lacking from thy meat offering : with all thine offerings thou shalt offer salt." (Lev. ii. 13). According to some of the Rabbinical commentators, the salt used in the sacrifice implied that purity of mind and sincerity of feeling necessary in all worshippers who desired to offer an

acceptable sacrifice to Jehovah. Others assert that the salt was an emblem of the fidelity of the covenant which God had established with His chosen people. But certain it is from the context that the use of salt with sacrifice and offering was based on its antiseptic properties. In verse 11 it is distinctly forbidden to use leaven with any meat-offering or burnt-offering. There is an evident antithesis between the interdiction of leaven and the commanded use of salt. Leaven, however useful, was regarded in its principle as a species of putrefaction, since that which is leavened very soon spoils in the warm regions of the East, whereas unleavened bread may be kept any length of time. At the present day, the cakes or bread offered in the ceremonies of the Hindoos are always unleavened, although leaven is in bread used for domestic purposes. On the other hand, the well-known preservative qualities of salt rendered it symbolical of incorruption and soundness, and therefore its adoption in the offerings was dictated by the same considerations, whether physical or figurative, which precluded the use of leaven. So far from the use of salt here being, as some think, in opposition to pagan practices, it is certain that salt was used by Greeks and Romans and other nations at a very early period in their sacrifices and oblations. Homer expressly mentions "sacred salt" as strewed upon sacrifices, and also speaks of offerings of salted cakes. In fact, salt occupies a conspicuous place in the heathen sacrifices both with and without blood. In the former, not only was a salted cake put on the head of the victim, but salt, together with meal, was strewed on the victims, the fire, and the knives. The custom is alluded to in Mark ix. 49:—"Every one shall be salted with fire, and every sacrifiice shall be salted with salt."

The salt used in the Temple was rock-salt, and considerable quantities were stored up in the Temple for use. It has been suggested that much of the rock-salt would naturally be mingled with clay or sand, and, being exposed to the air, some of the salt would absorb moisture, and thus waste away. The salt being thus deprived of its savour,

was scattered over the pavement, to render it less slippery in wet weather, or it was thrown out to mend the roads. To this it is thought that our Saviour alludes when He says to His disciples—"If the salt have lost his savour, wherewith shall it be salted? it is thenceforth good for nothing, but to be cast out, and to be trodden under foot of men" (Matt. v. 13). Some think that the Temple salt may have been brought from the Valley of Salt, because Maundrell, in his narrative of a journey to the Euphrates, says that about four hours' journey from Aleppo there is a precipice of salt, and that the part exposed to the sun and rain and air, though it had the sparkling of salt, yet had perfectly lost its savour. Another suggestion mentioned by Alford in his Greek Testament is that a kind of bitumen from the Dead Sea was called "Salt of Sodom," and was used to sprinkle the sacrifices in the Temple; which salt was utilized, when its savour was gone, to strew the Temple pavement, that the priest might not slip. Sir Lyon Playfair has suggested, that in this passage we should read "petroleum instead of salt." Visitors to the Health Exhibition may see at the stand of Messrs. Bumsted and Co. an actual sample of salt which has "lost its savour," and another sample taken from the same source which has *not* lost its savour. Mr. John Bumsted kindly communicated with the writer in reference to these samples, and the following is an extract from his interesting letter:—"Sea salt is not pure salt, containing, as you will see by analysis, with 89 parts of pure chloride of sodium, several other substances—some of them soluble and some not. All of course were dissolved in the sea-water except possibly invisible and transparent organisms, but my notion is that some of them may have changed their character after lying combined with the salt and exposed to the air, so that in fact they become insoluble. So we come to the salt that has lost its savour. Take a bag of salt, as per sample enclosed marked 'salt,' put it in a pail, pour fresh water on it, and run off the brine. Your salt will get small by degrees and beautifully less; continue the process, at last you will have a sediment which will not dissolve,

and will not taste salt, in fact, salt which has lost its savour. See second sample.—This is only a curiosity, and this is how it came about. In 'Good Words' for February, 1884, Sir Lyon Playfair contributed an article on petroleum (I think it was), and he gave some reasons for thinking that in St. Matthew 'petroleum' and not 'salt' is meant, for as the learned Professor says, 'Salt does *not* lose its savour.' Of course our English salt does not; you may crush it all away and you will find nothing; it is perfectly soluble. But I believe the salt that St. Matthew ate was like the salt made at Lisbon, Cadiz, Marseilles, and all round the sea in tropical countries, from sea-water. I am sorry to say I really don't know if salt is obtained from the *Dead Sea;* if it is, its waters may be purer or otherwise than sea-water. But I think my specimens show that if a great heap of salt like my sample No. 1, say some hundreds of tons, were to be exposed to a heavy downpour of rain for a few days, it would be the most natural thing in the world to find at the margin of the heap a quantity of salt which had lost its savour, and if 'the Master' were passing by at the time He could see the lesson and point it. This is the history of 'salt that has lost its savour.' My father has known this for a long time, but I believe it has not been observed by any one else, and in defence of the common-sense criticism of the New Testament, I venture to make this explanation. My samples have created a good deal of interest."

There are many other interesting passages in Scripture connected with salt. The prophet Elisha being desired to sweeten the waters of the fountain of Jericho, required a new vessel to be brought to him, and salt therein (2 Kings ii. 20). He threw this salt into the spring, and said (v. 21), "Thus saith the Lord, I have healed these waters; there shall not be from thence any more death or barren land." The "Valley of Salt" is placed by some writers to the south of the Dead Sea toward Idumea, because it is said (2 Sam. viii. 13), that David smote the Syrians in the Valley of Salt; and also that Abishai (1 Chron. xviii. 12),

"slew of the Edomites in the valley of salt eighteen thousand." The reference to Lot's wife and the Dead or Salt Sea are well known. We read too of the "Covenant of Salt" in Numbers xviii. 19.—"All the heave-offerings of the holy things, which the children of Israel offer unto the Lord, have I given thee, and thy sons and thy daughters with thee, by a statute for ever: it is a covenant of salt for ever before the Lord unto thee and thy seed with thee." And again, "Ought ye not to know that the Lord God of Israel gave the kingdom over Israel to David for ever, even to him and to his sons by a covenant of salt?" (2 Chron. xiii. 5). Some commentators explain this covenant by asserting that salt is an emblem of perpetuity, especially as there is in the East a kind of salt so hard as to be used for money; but others suppose that the covenant of salt refers to an agreement in which salt is used as a token of confirmation. Federal engagements among Eastern tribes are to this day ratified with salt; and oaths taken on salt are considered the most binding of all. The Hindoos swear by their salt, and during the great Indian mutiny the Sepoys were often held in restraint by being reminded that they had sworn by their salt to faithfully serve the Queen of England. Salt was often eaten on bread as a confirmation of a solemn promise given. Thus salt came to be the symbol of the fidelity due from servants and officers to those who maintained them: which will account for the governors of the provinces beyond the Euphrates writing to the King Artaxerxes, "because we have maintenance from the King's palace," &c. (Ezra iv. 14), which in the Chaldee is, "because we are salted with the salt of the palace," &c.

Allied to this idea of the sanctity, so to speak, of salt in connection with the making of any promise or compact, was that of its being the symbol and silent expression of hospitality, in the observance of which the common instincts of mankind have ever discovered a peculiar sacredness. Thus we find Cassandra aggravating the crime of Paris in stealing Helen on the ground that he has "contemned the

salt and overturned the hospitable table." Arabs still offer salt as a sign that their guest is safe in their hands; and even the Bedouin robber will not violate the laws of hospitality to one who has once tasted of his salt; the guest being also bound by reciprocal obligations. As an illustration of the strength of this bond, Price in his 'Mahommedan History' gives the following incident. "Yaakoob, the son of Eb-Leys Es-Suffar, having adopted a predatory life, excavated a passage one night into the palace of Dirhem, the governor of Seestan; and after he had made up a convenient bale of gold and jewels, and the most costly stuffs, was proceeding to carry it off, when he happened, in the dark, to strike his foot against something hard on the floor. Thinking it might be a jewel of some sort or other, he picked it up, and put it to his tongue; and, to his equal mortification and astonishment, found it to be a piece of rock-salt; for, having thus tasted the salt of the owner, his avarice gave way to his respect for the laws of hospitality, and, throwing down his precious booty, he left it behind him, and withdrew empty-handed, to his habitation. The treasurer of Dirhem repairing on the next day, according to custom, to inspect his charge, was equally surprised and alarmed at observing that a great part of the treasure had been removed; but on examining the packages that lay on the floor, his astonishment was not less to find that not a single article had been conveyed away. The singularity of the circumstance induced him to report it immediately to his master; and the latter causing it to be proclaimed through the city, that the author of this proceeding had his free pardon, further announced that, on repairing to the palace, he would be distinguished by the most encouraging marks of favour." It is further stated that Yaakoob availed himself of this invitation, relying upon the promise, which was fulfilled to him, and from this period he gradually rose in power, until he became the founder of a dynasty. In a less sacred way perhaps, but with much significance, an Abyssinian gentleman carries a piece of salt in his pocket,

and takes it out, and offers it to a friend to lick as a mark of respect and esteem.

As salt used in moderate quantities conduces to the fertilization of land, and was supposed by some to conduce to prolificness in animals, it came to be considered a symbol of desired production ; but *per contra*, as in districts where it forms the chief ingredient in the soil a barren desert is the result, it was taken to signify sterility and desolation. Thus, when Abimelech took the city of Shechem, he destroyed it and sowed the place with salt, that it might always remain a desert (Judges ix. 45). Zephaniah (ii. 9). thus threatens the Moabites and the Ammonites—"surely Moab shall be as Sodom, and the children of Ammon as Gomorrah, even the breeding of nettles, and salt-pits, and a perpetual desolation." And in the description of the wild ass and his haunts in Job xxxix. the "barren land" of verse 6 is in the margin "salt places."

Another well-known metaphorical application of salt is that to the mental faculties. Pliny, when arguing that human nature cannot exist without salt, says that it is so much an element of life that, passing from bodily sensation, it became from a very remote antiquity a metaphorical term for the pleasures of the mind. Salt is agreeable to the palate, and is therefore transferred to the mental taste. It is synonymous with whatever presents itself as piquant, lively, or agreeable to our mental faculties ; and further signifies more solid food for the mind which shall keep it pure and wholesome. It is in these senses that Pliny calls Greece *Sal gentium*, because it was to Greece that the whole world was indebted for intellectual sustenance. In a still higher sense, our Saviour, in the passage above quoted (Matt. v. 13), says to His disciples, "Ye are the salt of the earth," *i.e.* the means of preventing or curing the growth of that corruption which prevails in it, and seasoning men's minds with the salt of true wisdom. *Sal sapientiæ.* In a somewhat similar sense St. Paul says to the Colossians (iv. 6), "Let your speech be alway with grace, seasoned with salt ;" though, judging from the context, "salt" here

may have the further idea of "sound judgment," and also of "point," spiritual freshness, and piquancy. With the Latins the metaphorical meaning of *Sal*, *Sales*, *Salsa*, was mainly confined to wit and witticisms and "clever" talk, much in the same way as we still use the expressions "Attic salt" and "Sallies." But the words also were used of ill-tempered, biting sarcasm. The following story smacks both of the material and Attic commodity. Three Capuchin friars, travelling, arrived at an inn, but so poorly was it supplied, that a single egg and one pinch of salt was all they found there. At first they disputed the prize, but at last agreed it should become the property of the one who quoted from his breviary the most appropriate phrase. Accordingly the first took it and struck off the top, saying, "*sic conteret caput tuum;*" the second received it, and, putting in the salt, said, "*accipe sal sapientiæ;*" it was then passed on to the third, who swallowed it up, saying, "*intra in gaudium Domini.*"

But salt has also a metaphorical application in a coarser sense, signifying the strong passions associated with youth. Thus, in Shakespeare, Iago says, "hot as monkeys, salt as wolves in pride" (*Othello*, iii. 3). The Duke calls Angelo's base passion his "salt imagination," because he supposed his victim to be Isabella, and not his betrothed wife, whom he was forced by the Duke to marry (*Measure for Measure*, v. 1); and Shallow says, "Though we are justices, and doctors, and churchmen, Master Page, we have some salt of our youth in us." (*Merry Wives of Windsor*, ii. 3).

Passing on to social and other customs and superstitions connected with salt, we find that it was associated in many different parts of the world with witchcraft and magic, especially among Teutonic nations. An interesting suggestion is made in reference to this in Stallybrass's *Teutonic Mythology*. Referring to the salt-springs, which we know from Tacitus and others were highly valued by the early Teutonic tribes, he says: "Suppose now that the preparation of salt was managed by women, by priestesses; that the salt-kettle, salt-pan, was under their care and

supervision, there would be a connection established between salt-boiling and the later vulgar opinion about witchcraft: the witches gather, say on certain high days, in the holy wood, on the mountain, where the salt-springs bubble, carrying with them cooking vessels, ladles, and forks, and at night their salt pan is aglow . . . As Christians equally recognised salt as a good and needful thing, it is conceivable how they might now, inverting the matter, deny the use of wholesome salt at witches' meetings, and come to look upon it as a safeguard against every kind of sorcery. For it is precisely salt that is lacking in the witches' kitchen and at devils' feasts, the Church having now taken upon herself the hallowing and dedication of salt." It is curious that salt was both used in magic, and to defeat magical purposes. In reference to the later use, Aubrey says, "That salt is inimique to the Evill spirits is agreed upon by the writers of magick; as also perfumes, which is the reason they were used in their temples and sacrifices. Holy water is water wherein fine white salt hath been dissolved." Salt is used, according to the Roman Catholic ritual, in the fabrication of "Holy Water."

Salt superstitions and customs seem specially connected with the treatment of children. It would appear from Ezekiel vi. 4, that the Jews "salted" their infants in some way or other immediately after birth; but whether this was done from a belief in the medicinal value of the outward application of salt to their bodies, or as a religious ceremony, or simply from some superstition, it is difficult to conjecture. In the service of the Latin Church a pinch of salt (*parva mica*) is put into the child's mouth at baptism, the priest saying "Receive the salt of wisdom (*accipe sal sapientiæ*), and may it be a propitiation to thee for eternal life." Aubrey tell us that "when children shaled their teeth, the women used to wrap, or put salt about the tooth, and so throw it into a good fire," a custom said still to linger in Yorkshire. Dyer tells us in his *English Folk-lore* that when a child first leaves its mother's house, it is in Leicestershire, Lancashire, and other counties presented with salt.

In some parts of Scotland a new house, or one which a new tenant was about to enter, is sprinkled with salt to bring luck; and those who endeavour to be first to enter friends' houses on New Year's morning often bring bread and salt, in lieu of a present which the "first foot" is supposed to offer. But salt is not only used as a lucky thing, it is also employed in uncanny rites. Traces of this use we perhaps see in all cases where salt is burnt. For example, in the "salt spell," as it is called, a pinch of salt must be thrown into the fire on three successive Friday nights while these lines (Henderson's *Folk-lore of the Northern Counties*) are repeated —

> "It is not this salt I wish to burn,
> It is my lover's heart to turn,
> That he may neither rest nor happy be,
> Until he comes and speaks to me."

The people in North Lincolnshire hold the belief that if salt is not thrown into the fire before churning is commenced, the butter will not come. In the North-East of Scotland it is unlucky that milk should boil over the edge of the pot and run into the fire, as it diminishes the quantity of milk given by the cow, and salt should immediately be thrown into the fire to counteract the mischief. In the West of Scotland, if the evil eye had been bathed with salt and water, and had tasted the mixture, it was thrown "into the hinder part of the fire," the "skilly" neighbour who superintended the operations saying at the same time, "Guid preserve frae a' skaith." Probably, as the repetition backwards of the Lord's Prayer was said to raise the devil, so the unnecessary destruction of the life-necessary salt was equivalent to a propitiation of the powers of evil, Christian or pagan; salt in its proper use being esteemed holy.

It was a very common custom to place a plate of salt on the breast of a corpse after it had been laid out, the idea being that Satan, and evil spirits generally, hated salt, because it was an emblem of incorruption and immortality.

The practice still exists in some places, as also that of putting salt within the coffin. In the Highlands of Scotland it was a common custom to place on the breast of the deceased a wooden platter, containing a small quantity of salt and earth, separate and unmixed; the earth an emblem of the corruptible body—the salt an emblem of the immortal spirit. Herrick expresses the idea in these lines:—

> "The body's salt the soul is, which, when gone,
> The flesh soone sucks in putrefaction."

In some districts there was the further belief that salt laid on the breast of a dying person caused death itself to be more easy. To sprinkle meat with salt was thought by some efficacious in driving away the devil; and a quaint old divine speaks of one of unstable character as "loving no salt on his meat, for that is a sign of immutability."

We probably derive the well-known superstition as regards the bad luck attending spilling salt from the Romans, who considered it a bad omen if the salt fell from the head of a victim. This superstition is almost universally held among us now; or, rather, the custom of throwing some of the spilt grains over the left shoulder as a counter-charm is as universally observed, as of refusing to pass under a ladder, and of wishing when a piebald horse is seen. But these observances, though so generally practised, are seldom regarded as serious. According to orthodox believers in omens, the counter-charm of throwing salt over the left shoulder is useless unless it be done three times, with the use of the words "go to the devil," each time. In Leonardo da Vinci's famous picture of the Lord's Supper, Judas Iscariot is known by the salt-cellar knocked over accidentally by his arm. We all remember among the list of omens the line—"The salt was spilled, to me it fell": and old German housewives will tell a child that upsets salt that it will weep as many tears as there were grains spilt. The

Dutch still see in an overturned salt-cellar the symbol of a shipwreck.

The expressions "sitting above," and "below the salt" are familiar. The time-honoured custom in grand families of placing a massive piece of plate, called the salt-vat, or "foot," on the middle of the table was one that formerly obtained in France as well as in England and Scotland, the guests being seated above or below the vessel according to their several ranks.

> "Thou art a carle of mean degree;
> Ye salt doth stande twain me and thee,"

says an old English ballad, showing that sitting above the salt was the mark of a gentleman, or of a man of good connexions; while, to sit beneath it indicated a humble station in society. This distinction also extended to the fare; the wine frequently circulating only above the salt-cellar, and the dishes below it being of a coarser kind than those near the head of the table. It is, however, but right to add that some antiquarians have rather questioned all that is usually supposed to be implied in the phrase "below the salt." According to these critics, the sitting above or below the salt meant nothing more than having a place at the upper or lower end of the table, the relation which one's seat was said to bear to the salt being merely accidental, from the fact that the vessel containing it was the centre object. But the ordinary interpretation seems fully borne out by reference to various historical authorities; and the custom must be considered as one which debased salt from its high symbolism of hospitality to being used as a means of making invidious distinctions. In *Cynthia's Revels* by Ben Jonson, we hear of a character who takes no notice of any ill-dressed person, and never drinks to anybody below the salt. One writing in 1613 about the miseries of a poor scholar in the houses of the great, says, "he must sit under the salt—that is an axiom in such places." Even, strange to say, the clerical preceptor of the children had to

content himself with this inferior position, if we are to trust to a passage in Bishop Hall's satires—

> "A gentle squire would gladly entertain
> Into his house some trencher-chapelaine,
> Some willing man that might instruct his sons,
> And that could stand to good conditions:
> First, that he lie upon the truckle-bed
> Whiles his young master lieth o'er his head;
> Second, that he do, on no default,
> *Ever presume to sit above the salt;*
> Third, that he never change his trencher twice," &c.

A Scotch noble, again, writing in 1680 about his family and its old neighbours, introduces a derogatory allusion to the self-raised son of one of those against whom he had a spite, as coming of a family who, in visiting his (the noble's) relatives, "never came to sit above the salt-foot."

Proverbs, sayings, and metaphorical expressions are found in our own and other languages connected with salt. The expression "not worth his salt" is probably connected with the word *salarium*, the salt ration, or salt-money (*salarium*) of the Roman soldiers before alluded to; and the meaning of "He will not earn salt for his porridge" is sufficiently obvious. The Eton "Montem," now abolished, suggests that the word "salt" was sometimes used almost as an equivalent for "money," the captain of the school receiving on the little eminence at Salthill, near Eton, the "salt" or money collected on his behalf. But if this suggestion will not hold good, there is still a connection between salt and the Eton Montem in the fact that a certain number of the boys denominated "salt-bearers," attired in fancy dresses, scoured the country on the morning of Montem day, and levied a tribute of money from hundreds of persons who came, according to custom, to have tribute demanded of them. According to the ancient practice, the salt-bearers were accustomed to carry with them a handkerchief filled with salt, of which they bestowed a small quantity on every individual who contributed his quota to the subsidy. The origin of this

custom of distributing salt is obscure, but it would appear to have reference to those ceremonies so frequently practised at schools and colleges in former times, when a new-comer or freshman arrived, and, by being "salted" and after a variety of ceremonies more amusing to his companions than himself, was admitted to a participation with the other scholars in their pastimes and privileges. To take anything "*cum grano salis*" is to use caution in accepting a statement, or "to take a liberal discount off it," the idea apparently being that as salt is sparingly used as a condiment, so truth is sparingly scattered in an exaggerated statement or report. Then we have salt used metaphorically in a bad sense. "To salt an invoice" is to put the extreme value upon each article, and even something more, to give it piquancy and raise its market value. The French have the same expression, as *Vendre bien salé*, "To sell very dear;" *Il me l'a bien salé*, "He charged me an exorbitant price;" and generally *saler* is to "pigeon" one. Shakespeare and other old poets and writers use the word salt in a variety of metaphorical expressions.

Thus from whatever point of view we regard "Common Salt," it abounds with material for reflection; and it may almost be said that its historical associations, symbolic usages, and the customs and beliefs connected with it, are as interesting as its gastronomic, culinary, and medicinal properties are invaluable. Salt in some way or other confronts us, so to speak, at every turn; and there is little exaggeration in the old saying

SAL SAPIT OMNIA.

PART II.

CHAPTER IX.

MUSTARD.

SEVERAL botanically distinct species of plants are chemically similar in possessing powerful and peculiar smells and tastes, arising from the presence in them of allyl, which is the "radical" of the essential oils containing sulphur. Instances of this are garlic, onions, horse-radish, and mustard; and it is interesting to notice that without any knowledge of the close chemical relations among the plants in question, different races of men, in different parts of the world, have long selected and largely used them as condiments to their food. The Englishman, to a certain limited extent, relishes his onion, and the Frenchman mildly flavours his more savoury dishes with a touch of garlic or shallot. The Russian soldier fries his black bread with oil and onions. And mustard is almost everywhere a favourite condiment. Further considerations will probably show that these compounds of allyl exercise a peculiar physiological action upon the system, by which certain of its natural cravings are allayed, and its general comfort promoted.

Mustard has its historical interest as an article of domestic use. It was probably first used as a condiment in Asia, and found its way to Europe through Egypt in "classic" times. It is mentioned by Pythagoras, and was used in medicine by Hippocrates, B.C. 480. Pliny mentions that there were three kinds of mustard cultivated in his day. The Romans made considerable use of the seed in medicine, the oil being used for rubbing stiffened joints. It was also employed with vinegar as an outward remedy against stings of serpents and scorpions. Our Saxon

forefathers mixed it with honey, vinegar, and wine, as a condiment, but the first actual record of the use of mustard in England seems to occur in the household book of the Duke of Northumberland in the reign of Henry VII., where it is stated that 160 gallons of mustard seed was the allowance per annum for his retainers and servants. It does not appear that the seed was manufactured in those days, but was brought to table whole, where it was bruised and mixed with vinegar according to taste. Gerarde, the celebrated herbalist, tells us that garden mustard (the white seed) had not become common in the time of Elizabeth, but that he had distributed it to various parts of England to make it known. He remarks—"mustard makes an excellent sauce, good to be eaten with gross meats, either fish or flesh, because it promotes digestion and sharpens the appetite.

Prior to the date of about 1720 there was no such luxury as mustard in its present form at our tables. At that time the seed was coarsely pounded in a mortar, as coarsely separated from the integument, and in that rough state prepared for use. In the year mentioned it occurred to an old woman of the name of Clements, residing in Durham, to grind the seed in a mill, and pass it through the several processes which are resorted to in making flour from wheat. The secret she kept to herself for many years, and, in the period of her exclusive possession of it, supplied the principal parts of the kingdom, and in particular the metropolis with this article. George I. stamped it with fashion by his approval. Mrs. Clements regularly twice a year travelled to London and the principal towns throughout England for orders; and the old lady continued to make a considerable amount of money. From this woman residing in Durham, it acquired the name of "Durham mustard."

Like salt, mustard has given occasion to many proverbial sayings, and metaphorical expressions, both among the ancients and moderns, its heat being suggestive of "hot" temper and so forth. Thus the old Greeks spoke of an

angry man as "looking mustard" (σιναπι βλεπων); and the French still have the metaphor of "putting mustard up the nose" for the process of mentally irritating. There is not as much poetry about mustard as about salt, but it is frequently introduced by our old dramatists, for instance by Shakespeare in *As you Like it* (*i.* 2.), *Taming the Shrew* (*iv.* 3) and in *Henry IV.* (*ii.* 4), where Falstaff speaks of "Tewkesbury mustard."

Botanically the mustard is an annual "cruciferous" plant having several varieties, but best known in the form of *Sinapis nigra*, or black mustard, *Sinapis alba*, or white mustard, and *Sinapis arvensis*, or charlock. The two former are, however the only kinds actually cultivated for use as a condiment in this country. Black mustard, which constitutes the chief ingredient in edible mustard, is a plant which is found wild in all but the most northern parts of Europe, as well as in North Africa, Asia Minor, Mesopotamia, the Caucasus, India, Siberia, China, and naturalized in North and South America. It is cultivated extensively in Alsace, Bohemia, Holland, Italy, and on the richest alluvial soils in England, notably in Cambridgeshire, Lincolnshire, Yorkshire, and formerly Durham. It requires a very rich soil for its development in the greatest excellence, and great care is necessary in the planting and harvesting of the seed. The great aim of the grower is to produce reddish brown seed without any admixture of grey, which is attributed to rain. If unfavourable weather occurs as the time of ripening and harvesting the quality is much deteriorated, and the market value is reduced to a considerable extent. The seed of the *S. nigra*, which is of a reddish or blackish-brown colour, is very small in size, and yields in comparison with white mustard a much smaller proportion of flour when ground.

White mustard is the plant which is now largely grown as a forage crop for sheep, and also as a bulky organic manure to be ploughed in for grain crops. It is much more widely distributed than the black variety, and may be grown on almost all kinds of soil; nevertheless the finest

qualities of seed are grown in the alluvial soils of Essex, Cambridgeshire, and Lincolnshire. Holland also produces both kinds of seed, of fair quality ; but the chief places of production for really fine quality are the English counties mentioned above. The seed of the white mustard is yellow.

To the above species may be added *Sinapis juncea*, the brown or Indian mustard (rai) which is sometimes offered in London sales for black mustard. It is extensively cultivated in India, Central Africa, and other tropical countries. It flourishes particularly well in the saline soils of South Russia and the steppes lying North-East of the Caspian, some 800 tons of seed being annually prepared for table at Sarepta, in the government of Saratov.

It is very difficult to arrive at an estimate of the quantity of mustard seed produced and consumed annually, but it is certain that many thousands of acres in England are under cultivation with this plant for the purpose of seed. The yield on the average may be taken at about three quarters per acre, and four quarters would be an exceptionally good crop. The money value varies in the case of brown seed to a great extent from year to year, according to the season and the state in which the crop has been secured. but the average in recent years may be considered to be 13*s.* to 15*s.* for black, and 9*s.* to 11*s.* per bushel for white seed.

Mustard, from a chemical point of view, possesses very great interest, the composition both of the brown and white seed being peculiar and of a very complicated nature. They both contain a large proportion of fixed oil (about 36 per cent.). This oil is of a bland character, very much like rape oil, and possesses no pungency. The brown seed contains a substance known as myronic acid, which exists in combination with potash, and also another body called myrosin. When the flour of brown mustard seed is moistened with cold water a singular change takes place —the myrosin, which seems to act as a kind of ferment like disastase in malt, re-acts upon the myronate of potash and develops the volatile oil of mustard, an excessively pungent liquid, a mere drop of which applied to the

skin raises a blister in a moment. Thus the pungency of table mustard is the result of the peculiar fermentation which takes place immediately a sufficient quantity of water is added.

White mustard contains practically no myronic acid, but an acrid substance known as sinalbin, which is but slightly present in the brown seed; and hence we see a strong reason why in the mustards of commerce the farina of the two species should be blended together, as it is on the volatile oil and the acrid and somewhat bitter salt that the pungency and acridity of mustard depend. Of the two active principles the volatile oil is by far the more important, and hence the seed of the brown mustard possesses the greatest commercial value.

The following are the analyses of the farina of brown and white mustard as given by Dr. Hassall :—

BROWN MUSTARD FARINA.

Water	4·845
Fixed oil	35·701
Myronic acid	4·840
Myrosin and albumen	29·536
Acrid salt	3·588
Cellulose	16·765
Ash	4·725
	100·000
Volatile oil	1·271
Nitrogen	5·068
Sulphur	1·413

WHITE MUSTARD FARINA.

Water	5·360
Fixed oil	35·768
Acrid salt	10·983
Myrosin and albumen	27·484
Cellulose	16·295
Ash	4·110
	100·000
Nitrogen	5·285
Sulphur	1·224

The mustard of commerce, or table mustard, is one of those articles which has given rise to considerable discussion under the Adulteration of Food and Drugs Act of 1872; and more recently under the "Sale of Food and Drugs Act," of 1875. On the one hand it has been contended that pure flour of mustard only should be sold to the public. This view has been strongly advocated by prominent food analysts; while, on the other hand, men occupying equally high scientific positions see no reason to object to mixtures of mustard flour with suitable proportions of wheaten or rice flour, to moderate the somewhat coarse and bitter flavour of pure mustard, and to assist in preserving the article from decomposition, both in the dry and wet form, since perfectly pure mustard is very prone to undergo a change by variation of temperature and exposure to air which by no means adds to its value as a condiment, in fact, renders it offensive. The same authorities also see no objection to the use of turmeric, as a practically innocuous ingredient, which is used almost of necessity to restore or bring up the colour of the added flour to the original standard of the mustard farina. It is argued that in consequence of the presence of the pungent volatile oil, a condiment composed only of pure mustard flour, after being mixed for use, turns in a short time to a dark brown colour and becomes decomposed and unfit for use; and that therefore it requires to be mixed fresh every day; and this alone forms an objection in the eyes of most consumers, both on account of the inconvenience and the extra expense. To minimize this ill effect nearly all mustard manufacturers mix a certain proportion of the finest wheat flour, which helps to absorb the essential oil and has also the effect of enabling the mixed condiment to retain its sweetness and colour, and consequently its usableness, twice as long as the "genuine" mustard.

As an argument in favour of the presumed necessity of using some harmless diluent to absorb the excess of oil in table mustard, reference may be made to the practice of the Government Navy Victualling Yard, where rice flour is

used for this purpose, as may be seen in the series of Blue Books published yearly ; even ginger has been occasionally used and capsicum invariably, the fact being that pure mustard having any considerable proportion of the flavour-giving brown seed will not bear the climate of the tropics without serious deterioration.

That the sale of such mixed mustard was considered quite legitimate, it is only necessary to refer to the Report of the Select Committee of the House of Commons on the adulteration of food in 1874, where the following summary occurs (page 5) :—" Your Committee have had under their consideration the sale of mixed articles of food and condiments ; amongst them great prominence has been given to mustard (and cocoa). The evidence tends to show that these articles have been sold pure, as well as mixed with other ingredients to suit the requirements of consumers. And it has also been demonstrated to the satisfaction of your Committee that the compounds are frequently made quite as much to suit the public taste as to increase the profit of the manufacturers, inasmuch as by using a lower quality of mustard seed a pure article may be made at a lower price than some of the mixtures. It is also due to the manufacturer to record that the mixed mustard has long been manufactured at the Deptford Yard for the supply of the Navy. Your Committee therefore come to the conclusion that the sale of such mixtures or compounds is allowable, and indeed needful, to meet the public requirements, provided the fact of their being mixtures is plainly indicated to the purchaser by a legible label or notice conspicuously attached to the outside of each package in which, or vessel from which such mixture is sold.

Clause 6 of the " Sale of Food and Drugs Act " of 1875, before referred to runs thus :—

" No person shall sell to the prejudice of the purchaser any article of food or any drug which is not of the nature, substance, and quality of the article demanded by such purchaser, under a penalty not exceeding twenty pounds ; provided that an offence shall not be deemed to be com-

mitted under this section in the following cases; that is to say:

"Where any matter or ingredient not injurious to health has been added to the food or drug because the same is required for the production or preparation thereof as an article of commerce, in a state fit for carriage or consumption, and not fraudulently to increase the bulk, weight or measure of the food or drug, or conceal the inferior quality thereof."

This provision added to the clause is held to cover the manufacture of the mustard of commerce or "mixed" mustard.

Experience has proved that mustard is an article which requires very special management to ensure the best results as to flavour and keeping qualities, chiefly owing to the finer qualities of seed containing a very large proportion of fixed oil, in addition to volatile oil and sulphur compounds, which enter readily into chemical change under adverse circumstances. Natural mustard seed, like other products of the soil, differs enormously in value according to the locality of growth, season, harvesting, &c., but it is an invariable rule that the better the quality of the seed the more readily is this unfavourable decomposition induced. In order to make a satisfactory table mustard, or even an article for medical use, it is necessary, as has been above stated, to have a mixture of the two kinds of seed (*S. nigra* and *S. alba*), because the white seed, although possessing very little pungency, has within it a peculiar ferment, which develops the pungent flavour contained in the black seed, and it is upon the judicious mixture of these two sorts of seed that the quality of the mustard must depend, and, in fact, this is the art of the mustard manufacturer. It is evident from what has been said as to the difference in market value of seeds that a perfectly genuine mustard may be produced at very varying prices. The black seed, being much the dearer of the two, finds its way sparingly, as a rule into the lower qualities of the mustard sold to the public, and some makers, who make a

great point of manufacturing only genuine mustard, do in fact send out a pure article, but necessarily deficient in the true mustard flavour, that is to say, having little or no black mustard, because a large proportion of this seed would render the article very susceptible to change, and is, moreover, of greater pecuniary value.

The above remarks state the case put forward in favour of the manufacture of mustard as it has long been carried on. It is but right however to say that several well-known food analysts strongly condemn the prevailing custom. Dr. Hassall, for instance, after giving the analyses of a considerable number of samples of genuine mustard of different qualities, and of mixed or "adulterated" mustard, thus sums up his views :—

"It has already been pointed out that the turmeric is added to the mustard simply for the sake of its colour, and to cover and conceal the addition of the wheat flour. In favour of this addition it is believed that not a single reason can be adduced, except possibly that its use allows of the addition of a larger quantity of brown mustard-seed than could otherwise be employed at a given price, and that thus the public gain an advantage, wheat flour being, of course, cheaper than white mustard, which again is less costly than brown mustard ; but this difference in the cost must really be very inconsiderable, and if obtained at the expense of the purity of the article, the practice should be abandoned. At all events, it is wrong and misleading to call these mixed articles by the name of mustard. By making mustard in all cases either entirely of the brown seed or of admixtures of the brown and white seed, a wide range in the qualities and prices of mustard is obtained and the mustard in which the white seed greatly predominates can be sold, we know, at a very low price. We trust, therefore, that the time has now arrived for the abandonment of the use of wheat flour and turmeric in the manufacture of mustard, and that, if the sale of the mixtures still be allowed, the law will continue to render it compulsory that the mixed articles should be sold only as

mixtures, and not under the name of mustard simply. We even regard the manufacture of several varieties and qualities of the same article, as mustard for example, a very great evil, and the public suffers in pocket to a large extent thereby, the lowest qualities of these mixtures being constantly sold at the price of the higher, and especially is this the case in poor neighbourhoods. This is an evil which, so far, has been but little dwelt upon, but it is nevertheless most serious, and it vitiates the trade in the articles mustard, cocoa, and vinegar."

The actual process of manufacturing mustard is not a very complicated one, but as before stated, careful management is required to ensure the best results as to flavour and keeping qualities. Suffice it to say that the seed is crushed between rollers, pounded, sifted, and resifted into various qualities such as "superfine," "fine," "seconds," &c.

One of the most interesting features in the Machinery in Motion Department of the Health Exhibition is that contributed by the firm of Messrs. Colman, who show the whole process of mustard manufacture. They are the largest manufacturers of this condiment, and it may be truly said that there is hardly a remote corner of the world to which, like English beer, their product does not find its way. Their works at Norwich cover over 15 acres, and they employ over 2,000 hands. Their foreign trade is enormous, and perhaps some readers may be surprised to hear that in Paris English mustard is almost as popular as the French varieties, while in some French towns its consumption is even greater than that of the native product. This is probably the result of Messrs. Colman having shown their process at the Paris Exhibitions in 1867 and 1878, much in the same way as they are now showing it at South Kensington.

French mustard is chiefly made at Dijon, and as is the case with other continental mustards, is mixed with tarragon and other vinegars flavoured with a variety of herbs, spices, and other substances, with walnut or mushroom ketchup, or the liquors of the richer pickles. Hence they

have not the same pungency as our ordinary table condiment.

The common practice of preparing mustard for the table with vinegar, or still more, with boiling water, materially checks the development of those peculiar principles on which its pungency or strength almost entirely depends. To economize this substance, we should use lukewarm water only; and when flavouring matter is to be added to it, this is better deferred until after the paste is made.

Mustard is valued medically for poultices and also as an emetic, but beyond these uses it does not seem to be held in as high esteem as it was formerly. A few years since the use of mustard seed, by spoonfuls, *ad libitum*, was a common and fashionable remedy in torpor or atony of the digestive organs. The practice was a revival of that recommended by Dr. Cullen; but it has now again sunk into disuse. Sir John Sinclair also approved of the use of mustard seed in this way, especially for the preservation of the health of the aged.

At the same time, however, dietetic authorities seem generally agreed that the moderate use of table mustard is not only innocuous, but that it stimulates and assists the digestive organs when suffering from inactivity. Our forefathers appear to have used it as a condiment with more food substances than we now generally consider appropriate. Most of us would agree with the old writer in one of the earliest books published by Wynkyn de Worde at the end of the fifteenth century, who says "when you eat brawn be sure you have good mustard," and with John Russell, who in his quaint *Boke of Nurture* (Harleian MS. in British Museum) notes that "Brawne with mustard is concordable." But we should demur to his advice to eat it with "feysand, partriche, and cony," or with "samoun" (salmon), and a variety of other fish, as he recommends. Among the recognized palatal proprieties at the present time is the association of mustard with pork and beef, in the various forms in which they are served, but not with veal, mutton, or the white flesh of birds; and still less so

with oysters or roast hare, though with these last named delicacies two friends of the writer always eat the pungent condiment, much, it must be confessed, to his astonishment, and in spite of his endeavours to educate them out of these startling improprieties and offences against the canons of æsthetic gastronomy. But perhaps it must be allowed that this is "only a matter of taste:" and it will not do to contravene the old adage *de gustibus non est disputandum*, or since other condiments have yet to be considered, further in this direction to "trifle one's time away," as the French have it—*s'amuser à la moutarde.*

CHAPTER X.

PEPPER.

In common parlance there are three kinds of pepper in domestic use as condiments, viz.—black, white, and red or cayenne. This nomenclature however is not, strictly speaking, correct, as black and white pepper are produced from one and the same plant, and cayenne is not from a "pepper" plant at all.

The natural family of *Piperaceæ* includes four plants of great utility to mankind. Two of these, *Piper nigrum*, or black pepper, and *Piper longum*, more recently named *Chavica Roxburghii*, or long pepper, are chiefly employed for dietetic and culinary purposes; whilst others, *Piper cubeba*, now *Cubeba officinalis*, and *Artanthe elongata*, or the matico plant, are principally employed in medicine; and others again as narcotics.

The pepper of commerce is furnished by *Piper nigrum* and it is this species which now specially concerns us. It is indigenous to the forests of Travancore and Malabar, and is cultivated both in the East and West Indies, in Sumatra, Java, and other islands; and is a shrubby, climbing plant, which attains the height of from eight to twelve feet. The berries, or peppercorns, grow on terminal flower-stalks or spadices; they are at first green, but change subsequently to red and then to black. When any of the berries on a spadix have begun to turn red, the whole are gathered dried in the sun, and the stalks separated by the hand. In drying, the succulent part of each berry becomes contracted and wrinkled, forming a hardened wrinkled cortex; the corrugations being much raised, and describing a kind of elevated net-work. It climbs to the height of twenty feet, but is said to bear best when restrained to the height of

twelve feet. It begins to produce at about the third year, and is in perfection at the seventh; continues in this state for three or four years, and declines for about as many more, until it ceases to be worth keeping. The fruit grows abundantly from all its branches, in long small clusters of from twenty to fifty grains; when ripe it is of a bright red colour. After being gathered, it is spread on mats in the sun, when it loses its red colour, and becomes black and shrivelled as we see it. The grains are separated from the stalks by hand-rubbing. That which has been gathered at the proper period shrivels the least; but if plucked too soon, it will become broken and dusty in its removal from place to place. The vine produces two crops in the year but the seasons are subject to great irregularities. Those berries are the best which are not too small nor too much corrugated; which are heavy, and sink readily in water.

White pepper is produced by the same plant as the black pepper, and is preparcd by allowing the berries to ripen, keeping them for three days in the house after gathering, washing and bruising them in a basket with the hand till the stalks and pulp are removed, and then drying the white seeds. Sometimes white pepper is prepared from black by removing the dark outer layer of pericarp. The article is most largely prepared in the Straits, but the finest is produced in Tellicherry. China is the greatest market for it.

The active properties of pepper depend upon the presence of *an acrid resin*, *a volatile oil*, and a crystallisable substance called *Piperine*.

The use of white pepper instead of black is an instance of the sacrifices made to please the eye. Pure white pepper has only about one-fourth of the strength of pure black pepper, whilst it is nearly destitute of the fine aroma of the latter. It also contains a mere trace of piperina or piperine, one of the most valuable constituents of black pepper. Black pepper owes its pungency to about 2 per cent. of its essential oil; and it contains about 2½ per cent. of piperine.

Its whole constituents as given by Pelleter, are acrid soft resin; volatile oil; piperine, extractive, gum, bassorin, starch, malic acid, tartaric acid, potash, lime, magnesia, and salts; and woody fibre.

"Long Pepper" consists of the unripe spike or fruit produced by two other species of *Piper*, namely: *P. longum*, a native of Malabar; and *P. officinarum*, a native of the Indian Archipelago. In its general properties it resembles black pepper, but is less aromatic, though equally pungent. Elephant pepper is merely a larger variety of this species. The root and stems, sliced and dried form the "pippula moola" of India.

Jamaica pepper is made from the unripe berry of the *Eugenia pimenta*, which grows in the West Indies to the height of 20 or 30 feet, and bears flowers of an aromatic odour. The berries are gathered when green, and most carefully dried, after which they are of a brown colour. The flavour is much less pungent and more aromatic than that of black pepper, and is so rich as to be called allspice.

There is no need to mention any other species of pepper, nor the varieties of black and white pepper as distinguished and sold by wholesale dealers, nor again the flavoured or "scented" peppers, which are only the ordinary peppers of commerce with names indicating the additions made to them, or bearing mere fancy appellations. It is with the ordinary condiment of out cruet stand that we have mainly to do.

Unfortunately from its very constitution so to speak, or rather from the form in which it is sold, our pepper specially lends itself to adulteration. It has been found mixed with rice, sago, potato starch, linseed meal, chilis, husks of red and white mustard, wheat bran and flour, and ground gypsum or crystallised sulphate of lime. The stock material for adulterating pepper is the husks of red and white mustard seeds and linseed meal, warmed up with chilies. Add to these P. D. which is the symbol in the trade for another "assistant" signifying "Pepper Dust" consisting either of the sweepings of the warehouses, or else

of an article made up in imitation of ground pepper, and expressly used for the adulteration of that article.

This is a terrible list, but we may take courage in the belief that adulteration of our black pepper is not now practised to any very great extent, and that what we get at "respectable" shops fairly answers its purpose and is not injurious.

Black pepper has long been held to have medicinal virtues, and as a medicine it is often serviceable in nausea, vomiting, chronic diarrhœa, and agues. In North America a common remedy for the last is ½ oz. of ground pepper stirred up with a glassful of warm beer: or a like quantity made into a tincture by steeping it in 5 or 6 times its weight of gin, rum, or whisky for a few days.

As a condiment it is carminative, anti-spasmodic, and at the same time stimulant, affording some little relief in cases of deranged functions, especially with regard to the digestion of vegetables. Like most other ordinary condiments it may safely be said to assist the digestion of persons in a normal state of health, if taken in moderation. It is freely used throughout the world, and seems to meet an instinct of taste in civilized man. It was not taken by our ancestors as freely as mustard, for the simple reason that it was not so easily obtainable two or three centuries ago as it is now. As regards its appropriateness as a condiment with various kinds of food, it is safe to say without controversy and in a general way that it seems the most approved of when taken with those articles which demand the accompaniment of salt.

The plant from which cayenne is made, as has been already noticed, belongs not to the botanic order of the *Piperaceæ*, but to the *Capsicum* genus, in which is classed the *Solanaceæ* order including such apparently diverse members as the potato, the tomato, and tobacco. Cayenne pepper consists of the pods or seed vessels, ground and reduced to powder, of different species of *Capsicum*, but principally of *C. annuum*, *C. baccatum*, and *C. frutescens*; and it is the latter species, being stronger and better flavoured, which yields

the best description of cayenne pepper. *Capsicum annuum* is a native of America, but is cultivated in the West and East Indies, and to some extent in greenhouses in England and other European countries. It is an annual herbaceous plant, and one of the hardiest and most productive found in tropical climates, growing luxuriantly in almost all dry soils however indifferent. In this country it was grown as far back as the end of the 16th century. It flowers in July, and ripens its pods in October. When immature the berries are green, and only gradually become red as they grow ripe. They are used both in the green and red states, and in the undried and dried conditions; in the recent state they are employed for pickling; when dried they are used in medicine; and, reduced to powder, they constitute cayenne pepper. The pods of this capsicum are hot and pungent, but they have no aroma. The pods of *Capsicum frutescens* constitute what is known as *Guinea* or *Bird pepper*, and when ground they furnish the best description of cayenne pepper. They are small, scarcely an inch in length, a line or two broad, and of a deep orange-red colour. Each berry encloses about a dozen flattened, reniform seeds. The pods are hotter and more fiery than those of *C. annuum*.

The following is an analysis of Capsicum berries by Bucholz:

Acrid soft resin (*capsicin*)	4·0
Wax	7·6
Bitter aromatic extractive	8·6
Extractive with some gum	21·0
Gum	9·2
Albuminous matter	3·2
Woody fibre	28·0
Water	12·0
Loss	6·4
	100·0

Capsicum is the active principle of cayenne, and so pungent is it that a very minute quantity, even as little as half a grain, diffused throughout a room will set a whole party of people sneezing.

It is painful to think of the adulteration to which cayenne pepper is so easily subjected The list of "foreign substances" often mixed with it is very formidable. An authority says that the red pepper of the shops is often a spurious article, made by grinding a mixture of any of the reddish woods or sawdust with enough red pods or chilies to render the mixture sufficiently acrid and pungent. Common salt, colcothar, red bole, brick-dust, vermilion, and even red lead, are also common additions. It is even more adulterated than ordinary black and white peppers; and ground rice, turmeric, red earths, and salt are found in it in addition to the substances already mentioned. Most of the ordinary adulterants fortunately only affect the purchaser's pocket and not his health; but as Dr. Hassall says, the adulteration of cayenne with such substances as red lead and mercury is, doubtless, highly prejudicial to health. It has been stated that colic and paralysis have both been produced by the use of cayenne containing red lead. The salts of lead and mercury are characterized by the circumstance that they are apt to accumulate in the system, and so to produce symptoms of a very serious nature. Thus, no matter how small the quantity of mercury or lead introduced each day, the system in the end is slowly and insidiously brought under the influence of these poisons, and thus becomes seriously affected.

We must hope that matters are not practically as bad as professional analysts aver, and that our cayenne when purchased from shops which have a character to lose, is generally of a fair standard. When it is so, it may safely be used as a condiment by persons in ordinary health. But red pepper acts in some instances as an irritant. Where the lining membrane of the bowels is in a state of relaxation, as in summer diarrhœa, the action of this pepper is more directly astringent, but this action is only produced when administered occasionally. If habitually taken, cayenne pepper produces a congested condition of the whole alimentary canal, and particularly, engorgement of the liver. As a rule, dyspeptic patients had better avoid much cayenne.

There are other kinds of cayenne of which the space at disposal only admits a passing reference. There is, for instance, the Nepaul Cayenne, the best quality of which is ground in that country and sent away in tins. The Hungarian Paprika is another variety, something like the Nepaul pepper, the product of the *Capsicum annuum* as grown in Hungary. It is in high esteem in that country, and enters very largely into its cookery, which, without intending any reflection on it, is of rather a greasy character. Paprika is generally divided into four classes, according to its strength and colour. Samples of these can be seen in the Austro-Hungarian Court of the Health Exhibition, shown by Markó & Weyden of Budapest, the largest dealers in such commodities. The Hungarian Paprika would probably suit English tastes if trial were made of it.

Pepper is often mentioned by our old writers. Sir T. Elyot, for instance, in *The Castel of Helth* (iii. 17), speaks highly of it as a healthful condiment:— "The nature of *pepper* is, that beinge eaten it passes through the bodye, heatying and comforting the stomacke, not entrynge into the vaynes or annoyinge the lyuer." But Holland (*Plinie*, xii. 7), depreciates it thus:— "A fruit or berrie it is (call it whether you will) neither acceptable to the tongue nor delectable to the eye; and yet for the biting bitterness that it hath, we are pleased therewith, and we must have it fet foresooth as farre as India. What was he, gladly would I know, that ventur'd to bite of *pepper* and use it in his meats? Who might he be that, to provoke his appetite and find himself a good stomacke, could not make a shift with fasting and hunger only."

We find pepper mentioned in Shakespeare coupled with vinegar (*Twelfth Night*, iii. 4.) in the metaphorical sense of irritability. In a similar way we use the adjective "peppery" now. The verb to "pepper" had the early signification of "pelting as with pepper-corns," and so to "hit in many places," and to "wound smartly." We find this use more than once in Shakespeare; for instance,

Falstaff (1 *Henry IV.* v. 3.) speaks of his "ragamuffins" being "peppered"; and Romeo (*Romeo and Juliet*, iii. 1), says "I am peppered I warrant for this world: a plague on both your houses!" We still recognise this metaphorical use, and as a slang term, "give him pepper" is a common one.

CHAPTER XI.

VINEGAR.

VINEGAR, in some form or other, and produced by a variety of methods, is one of the oldest condiments of the world. We read of it in the Bible History of Ruth (Ruth ii. 14), and in the New Testament (Matt. xxvii. 34 and 48), but the "vinegar" here mentioned is probably rather a sour wine than what we strictly understand by the term. This remark may possibly apply to many passages in old authors where our translation of the word "vinegar" is hardly the correct one; though practically sour wine (*Vin aigre*), if it has undergone fermentation, is vinegar; and we must remember that the ancients well knew that the juices of fruits, after becoming vinous, i.e., alcoholic from fermentation, were subject to another change by which they were rendered sour. Vinegar was in use by the Greeks and Romans in Classic times. The Roman soldiery when campaigning mixed it with water as their ordinary drink, and we all know the myth of Hannibal forcing a pass for his army through the rocks of the Alps by the application to them of vinegar. In later days, Frederick the Great had each soldier supplied with it, and doubtless its use preserved thousands of men from the deadly effects of forced marches and unmedicated ditch water.

All liquids capable of vinous fermentation may be made to produce vinegar, but in all such cases the sugar is first converted into alcohol, and alcohol, by oxidation, into *acetic acid*—the acid of pure vinegar. It is to the presence of this volatile principle that vinegar mainly owes its aroma and pungency.

Vinegars may be classified according to their different sources ; but, it would answer no good purpose to enter minutely into the various processes used in their production. Suffice it therefore to say that in the manufacture of malt vinegar a mixture of malt and unmalted grain is mashed with hot water, and the resulting wort fermented, as in the common process of brewing. The liquor is then run into barrels, placed endways, tied over with coarse canvas, and arranged side by side in darkened chambers, moderately heated by a stove, and freely supplied with air. Here it remains till the acetous fermentation is nearly complete, which usually occupies several weeks, or even months. The newly formed vinegar is next run off into two large tuns, furnished with false bottoms, on which some "rape" (the pressed cake from making domestic wines, or the green twigs or cuttings of vines), is placed. One of these vessels is wholly, and the other only about three-fourths filled. The fermentation recommences, and the acetification proceeds more rapidly in the latter than in the former tun, and the liquor it contains consequently matures the sooner. When fit for sale, a portion of the vinegar is withdrawn from the smaller quantity, and its place supplied with a like quantity from the full tun, and this in its turn is refilled from the barrels before noticed. This process is carried on with a number of tuns at once, which are all worked in pairs. This vinegar usually contains a small quantity of sulphuric acid, the presence of 1–1000th part of which is allowed by law. Malt vinegar in this country is darkened in colour by caramel to suit the fancy of consumers.

Wine (French) vinegar is prepared in wine countries, from grape juice, and inferior new wines, worked up with wine-lees, by a nearly similar process to that adopted for malt vinegar. That prepared from white wine (white wine vinegar) is the most esteemed. It is purer and pleasanter than malt vinegar, and it usually contains from 5 to 6° of acetic acid. Wine vinegar is of course either white or red, according to the colour of the wine from which it is

prepared. It is held to be superior to the other kinds of vinegar, as it contains the flavour and aroma of the wine from which it has been made. It is sometimes flavoured by the addition of the wine, the presence of the alcohol increasing its aroma and pungency.

The German, or "quick-method" of making vinegar is based upon the fact that acetification is the mere oxidation of alcohol in contact with organic matter. Hence, by employing dilute alcohol, or liquors containing it, and by vastly enlarging the surface of the liquid exposed to the air at a proper temperature, the period occupied in acetification may be greatly reduced. The process is conducted in large vats, capable of each holding from 6,000 to 10,000 gallons of wash; each vat is half filled with the liquid to be acetified, and the upper half with bundles of birch, such as are in general use for brooms. The pump in the centre elevates the liquor, and, by means of its rotative motion, disperses it in a shower over the surface of the bed of birch, and in descending through the same it is met by a small ascending current of atmospheric air, which, coming in contact with the multiplied surfaces of the liquor trickling through the twigs, speedily acetifies it; the whole being kept up to the proper heat by a steam-pipe of pure tin passing through the vat. The acetification is generally completed in twenty days, but varies in inverse ratio to the proportion of birch to the wort to be acetified; and the whole operation, mechanical and chemical, being performed by steam, no manual labour of any kind is required, save the occasional inspection by the manager to ascertain when the process is finished.

Vinegar is frequently prepared on a large scale from sugar, beat, and cider, as also occasionally from fruits other than the apple, as pears, gooseberries, currants, &c. The vinegar made from apples, pears, and other fruits is distinguished by the presence of malic acid. Dr. Stenhouse has even recommended the use of seaweed for the manufacture of vinegar. This, when subjected to fermentation, with the addition of lime, yields acetate of lime, which may

be decomposed with sulphuric acid, thus furnishing a more or less pure acetic acid.

By submitting wine or malt vinegar to distillation, the acetic acid and all the volatile constituents are obtained in the distillate, which is known as distilled vinegar. It should be remembered, however, that the vinegar thus obtained is always weaker than that from which it is derived, and this because the boiling-point of vinegar is higher than that of water. The distilled vinegar of wine often contains a small quantity of alcohol.

The various flavoured, or spiced vinegars used as condiments, but mainly employed in cookery, are sufficiently indicated by their titles, such as Tarragon, Chili, Capsicum, Horse-radish, Garlic, &c. &c. ; while the flavoured vinegars known as Raspberry, Cowslip &c., &c., are merely beverages ; but it may be noted that the sugar added to them is in a great measure converted into vinegar, while the fruits contribute in some cases a proportion of it, but chiefly their peculiar flavour.

Nearly all vinegar manufacturers supply at least four different strengths or qualities of common vinegar, but as the numbers attached to their productions do not indicate absolute but relative strengths, the vinegars of different makers having the same number vary considerably in the amount of acetic acid contained in them. Good vinegar should contain 5 per cent. of anhydrous or pure acetic acid.

The principal adulterations of vinegar are, according to Dr. Hassall, with water, sulphuric acid, burnt sugar, and sometimes with acrid substances, as chilies and grains of paradise, and also with acetic and pyroligneous acids. The water is added to increase its bulk, sulphuric acid and acrid substances to make it pungent, and burnt sugar to restore the colour lost by dilution. Some of the vinegars sold at small huckster's shops, and at oyster stalls, consist of little else than diluted sulphuric acid, and water coloured with burnt sugar. Now, the law allows the addition of one part of sulphuric acid to 1000 of vinegar, and it is only when the quantity exceeds that amount that it can be considered

as an adulteration ; and this it very frequently does. The use of this quantity of sulphuric acid was permitted on the plea, urged by the manufacturer, that it was necessary in order to make the vinegar keep. That it is not requisite to the preservation of well-made vinegar is shown by the circumstance that several manufacturers, especially those who make use of the quick vinegar process, do not use sulphuric acid at all ; and yet the vinegar made by them keeps perfectly well. As has already been noticed, the same practice prevails in the article vinegar as in mustard ; no less than four, and even five qualities of vinegar being made, differing only in strength. The consequence of this system is, that of vinegar bought at several different shops, some will be found to contain two or three times less acetic acid, the active ingredient of the vinegar, than others, although the same price is paid for them all. This system, therefore, affords great facilities for imposition. Very commonly, after the manufacture of the vinegar has been completed, the strength is brought up by an addition of acetic acid. Dr. Hassall is of opinion that this practice is to be regarded as an adulteration. To allow of this addition would be to acknowledge that a mixture of acetic acid and water really constituted vinegar, which is far from being the case, since genuine vinegar contains extractive matters of different kinds as well as certain volatile principles, and which affect both the aroma and the flavour. Other adulterations described in books, the majority of which are probably of unfrequent occurrence, consist in the addition of nitric, hydrochloric, and tartaric acids, alum, salt, spurge flax, mustard, pellitory, and long pepper. Vinegar is not unfrequently contaminated with arsenic, this being introduced through the sulphuric acid used in its adulteration.

Notwithstanding these adulterations, many of which Dr. Hassall detected in the samples he analysed, vinegar of excellent quality and at a moderate price may now be obtained in every part of the country, so that it is no longer necessary to make it at home ; but the following receipt will

produce it; viz., 1 gallon of water, 1¼ lb. of raw sugar, and ¼ pint of yeast. At a temperature of 80° it will be sufficiently acid in three or four days to be drawn off, when an ounce of cut raisins and the like weight of cream of tartar should be added, and after a few weeks the sweet taste will have entirely disappeared, so that the fluid may be bottled. A more simple method for the production of a small quantity is to procure the vinegar plant (*Penicillium glaucum*) and place it in a weak solution of sugar in a warm place for a few days. The same plant will continue to increase and may be used again and again for the same purpose. The production of vinegar from any saccharine material is accompanied by a fungoid plant, so that vinegar produced in the purest manner from wine-lees deposit a material called "Mother of Vinegar," which is a mycoderm, *Micodermi Vini*, and when added to weak alcohol produces vinegar. It consists of cellulose and a nitrogenous principle. The process has, however, some connection with the extractive substance of plants, for when that of wine is lost by age the acetous fermentation is not easily produced. Among the most reliable vinegars now offered to the public are those bearing the names of Campion, Sarson, and of Messrs. Hills and Underwood.

The medical use of vinegar is well known, but, generally speaking, it is not so highly esteemed as it was in the generations which have immediately preceded us, its value as a remedy for hiccough, blood-spitting, and, when boiled with honey, as a gargle for sore throat, or as a mixture for cough, not being so fully recognised as it once was. Its use, however, for sprains and bruises, for its cooling and reviving properties when applied to the face of persons suffering from great heat or from fainting, is fully acknowledged, while for toilet and veterinary purposes (if it be not wanting in good taste to class these together) there are a variety of ways in which it does good service. Nor should its value as an antiseptic and food preservative be forgotten, its efficacy in reference to "soused" or "pickled" fish being very marked.

But it is with the use and value of vinegar as one of our common condiments—a member of the domestic cruet-stand—that we are more immediately concerned. There seems to be a very widely spread craving for more or less of palpable acid of some kind or other among the inhabitants of almost all countries of the world. The total quantity of vinegar consumed in this country is much greater than is usually supposed, especially among those whom we term the middle and lower classes, and particularly among the latter, who have probably been led to use it extensively as a kind of set-off to their tasteless and distasteful food. It may, therefore, be ranked as a valuable food accessory, second, perhaps, only to salt. When taken in small quantities acetic acid, if not too strong, exercises a digestive influence upon the gelatinous constituent of the harder portion of meat. Cold meat creates a demand for some such solvent, and pickles, in which vinegar is the principal element, supply this requirement.

Vinegar also, especially when combined with oil, enables uncooked vegetable matter to be digested by thousands who could not tolerate raw vegetables without it; the acidity of the vinegar being counteracted to some extent by the smoothness of the oil, while the oil is rendered more palatable by the vinegar, and in addition to its food value acts as a mechanical lubricant to the intestines. At the same time, however, although the acetic acid is transformed into carbonic acid, and so far is a food, it would be a refinement to say that vinegar supplies nutritive materials; and therefore it is not safe to go further than to say that its chief and almost sole use is to flavour food, and stimulate the nerves of taste.

As in the case of mustard and pepper we must not attempt to lay down any hard and fast line as to the particular kinds of food with which vinegar is most appropriately eaten. *Chacun à son gout;* but few of us would be disposed to agree with the author of "Boke of Nurture" quoted in the two previous chapters who suggests it as a condiment for goose (goos), and roast beef (roost beeff),

though, as a matter of fact, we do use it with the latter when it is accompanied with horse-radish sauce and beet-root.

Like several other condiments, vinegar is mentioned in the old dramatists, and has in many nations given rise to proverbs, proverbial sayings, and metaphorical expressions. Sir Andrew Ague-cheek, in Shakespeare's *Twelfth Night* (iii. 4), says "Here's the challenge, read it; I warrant there's vinegar and pepper in't." In the *Merchant of Venice* (i. 1) Salarino speaks of human beings of "vinegar aspect." And so we have the expression now of "a sour look." Both among the Greeks and Romans there was the same metaphorical use of vinegar, but with the latter the word *acetum* (vinegar) had metaphorically not only a bad meaning but a good one; at least as we gather from Plautus it was used something like *sal* (salt) to signify "pungent wit."

CHAPTER XII.

SAUCES—PICKLES—CURRIES—SPICES.

HAVING now passed in review the condiments which are the ordinary occupants of our cruet stands, and in most general use, a few concluding words in reference to some few other food accessories may not be inappropriate. Their name is "Legion," if the word condiment be taken to include all "substances used with food to season or improve its flavour, or to render it more wholesome and digestible;" but as intimated in the Introduction, such a wide field as this could never be covered in a handbook like the present, which has already exceeded the space originally contemplated.

Sauces are certainly condiments in the sense of the word, as signifying "concoctions," or combinations of various substances which make a homogeneous whole. In classic times pungent sauces were considered as necessary for most kinds of fish, as they are now, and Greek and Romans *bons vivants* were very particular about their *garum* and *alec.* Both these celebrated sauces were manufactured from fish, and salt of a highly aromatized kind was very largely used in their production. Garum was originally made from a fish called by the Greeks *garon*, but only known at Rome in Pliny's day as a sauce. That manufactured from the mackerel of New Carthage, and further named "*garum sociorum*," (Allies' Sauce) in supposed compliment to the Spaniards, then in alliance with Rome, was reckoned the best. Strabo bears testimony to the excellence of the Carthagena sauce; but the article soon came to be imitated in Italy out of Campanian scombers, and other sea fish, till, as the demand increased, a great variety of fishy compounds came to be

offered to the Latin public, each bearing on the bottle a label with the old name, and pretending to be concocted form the original recipe. These imitations, as we learn, were of very unequal merit, the liquor sometimes running thick and turbid, as the epithet applied to it, *fæcosum*, sufficiently indicates ; but in general, though varying greatly in taste, quality, consistence and colour, they were defecated and clear. Garum was everywhere held in the highest esteem, and notwithstanding the number of different fish used in the preparation, the demand was so constant that dealers sought to increase the quantity, and heighten the flavour, by mixing with it a variety of other fluid ingredients, as oil, wine, vinegar and waters. Hence recognised "brands," took the several names of "elaiogarum," "oinogarum," "oxygarum," and "hydrogarum," which were used not only as fish sauces, but as liqueurs to stimulate the appetite, and we are told—

> "That all the topers, to prepare 'em,
> Drank every man his glass of garum."

Some garum, of an expensive kind, costing, as Pliny tells us, as much as five hundred sesterces a gallon, was made from the blood of the thunny and other fish, and those who made a present of a flask of it to friends, generally took care to allude to its value :—

> "Of Scomber's precious blood I send
> A *garum'd* bottle to my friend ;
> Costly and thick, the last that dript
> From bleeding gills and entrails ript."

Alec, like garum, was at once the name of a fish and of a sauce made from it. This differed from the garum only in being thicker, being generally made from the dregs and feculence which remained after the garum liquor had been decanted off clear. The fish originally used for this sauce is said to have been the "halecula," though many other small species were afterwards pressed into the service, salt being largely employed. The halecula was a small and comparatively worthless fish for eating, but of strong

flavour, and dissolving in brine more readily than any other. Thus it corresponds with the anchovy, and its identity with this fish seems further established by the fact that the modern Italian name of the little clepea is *alici*, which looks like the melting down of *halecula* into soft Latin. If this be so, we have many centuries ago the "original" anchovy sauce. Garum was still in Belon's day manufactured by the Greeks at Constantinople. Several attempts have been made to revive ancient sauces in modern times: and Rondolet, in particular, of one bearing, he says, comparison with the best of those gone by. His plan in preparing it, was to macerate anchovies in oil and vinegar, well spiced and seasoned with chopped parsley over a slow fire, till the whole was dissolved. He writes of his "oxygerum" with enthusiasm, declaring it "wholesome and savoury, and fit to set before a king."

The sauces offered to the British public are of such "infinite variety" that we might almost say—"*quot homines tot* sauces." The names of many are very familiar, owing to extensive advertisement, often accompanied with clever artistic illustration. Several have quite a history attached to them as regards their "invention," and possess a distinctive character; but it is not far from the truth to say that many of them are "very much alike." This likeness arises from the fact that the basis of so many popular sauces, made not only in this country but on the Continent, is soy. This useful condiment is prepared by the Chinese and Japanese from the fruit of the *Soja hispida*, which holds an important place among the oil-yielding plants. The sauce is prepared by boiling the beans with an equal quantity of roughly-ground barley or wheat, and leaving it covered for twenty-four hours to ferment. Salt is then added in quantity equal to the other ingredients, and afterwards water, and the whole is stirred at least once daily for two months, when the liquid is poured off, squeezed, filtered, and preserved in wooden vessels, in which it becomes brighter and clearer by long keeping. In the London market the Chinese soy fetches a higher price than the

Japanese, its quotation being from about *2s. 3d.* to *3s.* per gallon.

A famous wit and gourmet, when dining in company with three most distinguished men of Science, is recorded by Brillat-Savarin to have said :—" I consider the discovery of a new dish as a far more interesting event than the discovery of a star ; for dishes increase the sum of human enjoyment, whereas there are always plenty of stars to be seen." The inventor of a really new sauce would win the suffrages of the gastronomic world, and for ever be looked upon as a benefactor to his species ; though we must not forget the old adage that " hunger is the best sauce."

Sauces of all kinds offer great facilities for adulteration, and for production from worthless or unwholesome substances. The foolish notion that soy is often obtained from a decoction of black-beetles or cock-roaches is hardly worth mentioning ; but treacle and salt are employed in the fabrication of a spurious article. In anchovy and other red sauces and pastes " bole armenian " is used for colouring purposes, but not to the same extent it was some years ago. The ferruginous substance just named is a natural earth, containing a large quantity of the red oxide of iron : but frequently an article is made in imitation of it, consisting of a mixture of Venetian red and chalk. Of this red earth or dirt, as much as from 10 to 15 lbs. have been added to 100 gallons of anchovy sauce. Perceiving clearly the evils connected with the employment of artificial colouring matters, many of the most respectable manufacturers have, to a very great extent, abandoned their use, except in the case of anchovy sauce, which they state to be almost unsaleable without a small quantity of colouring matter. The difference between the ordinary coloured, and the uncoloured sauce is very striking, the former being bright red, and the latter of a dull pinkish colour. Moreover, the use of colouring matter involves considerations of cleanliness, and this is especially the case with anchovy sauce. The quantity of refuse and dirt in the fish from which it is prepared is very great, and they are exceedingly difficult of

removal. Hence the use of bole armenian to conceal them. But though some manufacturers have spared no labour to produce a first-class uncoloured article of improved quality and flavour, buyers have persistently refused to give up the old tradition.

Another sauce of a very unreliable character is walnut ketchup. Large quantities of this on chemical examination are found to abound with copper. Indeed this condiment is said to be often nothing else than the residue left behind after the process employed for obtaining distilled vinegar, subsequently diluted with a decoction of the outer green husk, and seasoned with allspice, cayenne pepper, pimento, onions, and common salt. Mushroom ketchup also is often very doubtful as to its origin, being not unfrequently quite innocent of mushrooms. Both these commodities are better made at home from recipes given in standard cookery books, or obtained direct from some farmhouse where they pride themselves on producing genuine ketchups. Dwellers in London, and other large centres of population should, however, be on their guard against "young men from the country," and for the matter of that, against old men and women too, with an assumed rural look and dress who occasionally call from house to house in quiet streets, and offer "real farmhouse-made ketchups" at a very tempting price. The ketchup is "home-made" certainly, but is manufactured in Whitechapel, Bermondsey, or some such locality.

As a rule, a moderate quantity of good sauce taken with fish or meat is not unwholesome, but rather the contrary, as by giving a relish to food, it sharpens the appetite, and as a stimulant, assists the digestion of persons in a normal state of health.

Much that applies to sauces applies to pickles, which are a valuable food accessory, especially to the humbler members of the community, who eat a great deal of cheese, and a variety of food which requires the addition of condiments in some form or other. It stands to reason, however, that too free a use of pickles must be injurious

in many ways, particularly if they are cheap pickles of inferior vegetables put up with inferior vinegar, and adulterated with copper. Moreover, pickles in themselves are not very digestible.

It might be thought that all must be straightforward as regards the vegetables used; but "gherkins," on close examination, sometimes turn out to be but shrivelled or sliced cucumbers: "young tender beans" to be old and tough; the "cauliflowers" to have run to seed, and the "red cabbage" to be nothing more than white cabbage turned into red by colouring matter, as a dyer would change the colour of a dress; while vegetable marrows and sliced turnips sometimes do duty for more aristocratic vegetables.

But the adulteration of pickles is of more consequence, as this is a question of the quality and composition of the vinegar used, and the means employed for preserving and heightening the colour of green pickles. From Accum's well-known work "Death in the Pot," the following information is given in reference to the "greening" of pickles: "Vegetable substances preserved in the state called pickles, by means of the antiseptic power of vinegar, whose sale frequently depends greatly upon a fine lively green colour, and the consumption of which, by seafaring people in particular, is prodigious, are sometimes intentionally coloured by means of copper. Gherkins, French beans, samphire, the green pods of capsicum, and many other vegetable substances, oftener than is perhaps expected, are met with impregnated with this metal. Numerous fatal consequences are known to have ensued from the use of these stimulants to the palate, to which the fresh and pleasing hue has been imparted according to the deadly *formulæ* laid down in some modern cookery books, such as boiling the pickle with half-pence, or suffering them to stand for a considerable period in "brazen vessels." In some cases copper, usually the sulphate, commonly known as *blue stone*, is added direct to the vinegar. More frequently, however, no direct addition of copper is made, but

a sufficient quantity of that metal in the form of an acetate, is obtained by the repeated boiling of the vinegar in copper vessels ; but since vinegar is so frequently adulterated with sulphuric acid, sulphate of copper is generally formed as well. Thus it amounts to the same thing whether the copper is added direct to the pickles, or whether it is taken from the copper utensils by the action of the acids in the vinegar.

The presence of copper in pickles can of course be detected by various chemical tests, but it is often unmistakably indicated by their colour. When the housekeeper makes her own pickles, they are usually of a yellow colour rather than green, but as exhibited in shop windows they frequently present a vivid bluish-green colour, more intense than that of the fresh vegetables. Whenever pickles are of a very decided green, they will almost always be found to contain copper, but when they are yellowish or brownish-green, copper is not present. Vinegar of good quality ought to contain from 4 to 5 per cent. of pure acetic acid ; but the vinegar with pickles has often been found of a very weak description, the percentage of acetic acid ranging from 1·48 to 2·91. Of course it is an adulteration when free sulphuric acid beyond the proportion allowed by law in vinegar is found in pickles.

It is most satisfactory to know that a very great improvement has been made in the manufacture of pickles during the last few years, and the practice of "greening" them has very generally been abandoned. The productions of high class manufacturers, whose names are familiar to most of us, may be thoroughly depended on.

Pickle making, it appears, is to a great extent independent of the seasons ; and most of the different kinds of pickles may be made at any period of the year, as manufacturers keep a large stock of various vegetables immersed in brine. They are thus enabled to put up a regular quantity of pickles daily, and to meet a sudden demand for any special kind. Perhaps the vegetables would be better roughly stored in vinegar, but brine is used for the sake of economy.

Curries form as it were a class to themselves, and a long chapter would not exhaust the subject of their composition. Curry powder is certainly a condiment, or food accessory, and not a food. Several ingredients enter into its concoction; that of good quality containing turmeric, black-pepper, coriander seeds, cayenne, fenugreek, cardamoms, cumin, ginger, allspice and cloves. Of these different manufacturers use different proportions. The famous Ceylon curry powder is said by Dr. Balfour to have the following rather indefinite composition—A piece of green ginger, two fragments of garlic, a few coriander aud cumin seeds, six small onions, one dry chili, eight peppercorns, a small piece of turmeric, half a dessert spoonful of butter, half a cocoanut, and half a lime. Curry powder seems an absolute necessity for the poorer natives of India and the East, who are enabled to live almost entirely on rice flavoured with a few pinches of the condiment. In this country, though much might be advanced in its favour, it is hardly ever used by the poorer classes. Some years ago the benevolent Duke of Norfolk urged its use in times of distress, but in vain. But curry in England and curry in India are two very different things, the latter whenever possible being made with freshly bruised ingredients. The great principle of curry making in the East seems to be the employment of cayenne to give heat, of fruit to give acid, and of raisins or sugar to give sweetness.

Curry powder is another of those articles which lends itself easily to adulteration, which is effected by any starch or farina, or any vegetable substance added for the sake of bulk and weight, or added mineral matters, especially those employed in the coloration of cayenne.

But notwithstanding the superiority of fresh made curries to those prepared with the ordinary curry powders of commerce, many excellent varieties of the latter, and of substances curried in tins, are to be procurred in this country. For instance, the well-known tinned curries of Mr. Halford, once chef to Lord Dalhousie when Governor-General of India, leave nothing to be desired, so exact are

they to the "native" pattern; and visitors to the Health Exhibition will find "something to their advantage" at the stands of Mr. W. Bowden, of Mr. Edmunds, and of Messrs. Wix & Sons, where they can learn much in the matter of curries, chutnies, sauces, pickles, and condiments, generally; the "Kaisar-i-Ind" Anglo-oriental pickle, and the "Criterion" sauce, of the last-named firm, being specially worthy of notice.

Spices form another large class of condiments in the wide acceptation of the term. They were highly esteemed from remote antiquity, and in very early times were a principal article of merchandise. They were also acceptable presents even to a king; and we read "neither was there any such spice as the Queen of Sheba gave King Solomon." So important were they even in our cold climate, that in our early history the spicery was a special department of the Court, and had its proper officers. They were necessarily rare and costly in the 14th century, since they were imported from the Levant, and were not then in general use. Chaucer and Wicliffe, and other old writers, mention many by name; and among the recorded ingredients of old recipes we find cinnamon or canella, mace (macys), cloves (clowe), galyngal, ginger, cubebs; grains of paradise (or de Parys), nutmegs, caraway, and spykenard de Spagne. These and many others are still in use among us; but being mostly employed for culinary purposes and for flavouring drinks, they hardly come under that class of condiments which have mainly formed the subjects of the preceding pages.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED,
STAMFORD STREET AND CHARING CROSS.

OFFICIAL PUBLICATIONS.

The following Handbooks upon subjects cognate to the International Health Exhibition are already published, or in active preparation :—

HEALTH IN THE VILLAGE. By Sir HENRY W. ACLAND, K.C.B., F.R.S. *Illustrated.* [*Now Ready.*

HEALTHY NURSERIES AND BED-ROOMS, INCLUDING THE LYING-IN-ROOM. By MRS. GLADSTONE. [*Now Ready.*

HEALTHY AND UNHEALTHY HOUSES IN TOWN AND COUNTRY. By WILLIAM EASSIE, C.E., F.L.S., F.G.S., etc., with an Appendix by ROGERS FIELD, B.A., M. INST. C.E. *Illustrated.* [*Now Ready.*

HEALTHY FURNITURE AND DECORATION. By ROBERT W. EDIS, F.S.A., Architect. *Illustrated.* [*Now Ready.*

HEALTHY SCHOOLS. By CHARLES E. PAGET, M.R.C.S. [*Now Ready.*

HEALTH IN THE WORKSHOP. By JAMES B. LAKEMAN, Esq., H.M. Senior Metropolitan Inspector of Factories, Home Office. [*Now Ready.*

ON VENTILATION, WARMING, AND LIGHTING FOR DOMESTIC USE. By Captain DOUGLAS GALTON, C.B., F.R.S. *Illustrated.* [*Now Ready.*

DIET IN RELATION TO HEALTH AND WORK. By A. W. BLYTH, M.R.C.S., F.C.S., &c. [*Now Ready.*

ON THE PRINCIPLES OF COOKING. By SEPTIMUS BERDMORE. [*Now Ready.*

FOOD AND COOKERY FOR INFANTS AND INVALIDS. By Miss WOOD, with a Preface by W. B. CHEADLE, M.D., F.R.C.P. [*Now Ready.*

ALCOHOLIC DRINKS. By JOHN L. W. THUDICHUM, M.D., F.R.C.P. (Lond.), etc. [*Now Ready.*

WATER AND WATER SUPPLIES, AND UNFERMENTED BEVERAGES. By Professor ATTFIELD, Ph.D., F.R.S. [*Now Ready.*

ENGLISH AND EXOTIC FRUITS. By W. T. THISELTON DYER, M.A., C.M.G. *Illustrated.*

SALT AND OTHER CONDIMENTS. By J. J. MANLEY, M.A. [*Now Ready.*

LEGAL OBLIGATIONS IN RESPECT TO DWELLINGS OF THE POOR. By HARRY DUFF, M.A., Barrister-at-Law ; with a Preface by ARTHUR COHEN, Q.C., M.P. [*Now Ready.*

"OUR DUTY," or MORAL RESPONSIBILITY OF THE INDIVIDUAL IN REGARD TO HEALTH. By G. V. POORE, M.D., F.R.C.P. [*Now Ready.*

PUBLIC HEALTH LABORATORY WORK. By W. W. CHEYNE, F.R.C.S. ; W. H. CORFIELD, M.D., M.A., F.R.C.P. ; and CHARLES E. CASSAL, F.I.C., F.C.S. *Illustrated.*

PHYSIOLOGY OF DIGESTION AND THE DIGESTIVE ORGANS. By ARTHUR GAMGEE, F.R.S. *Illustrated.*

FERMENTATION. By Dr. DUCLAUX ; with a Preface by M. LOUIS PASTEUR, Membre de L'Institut.

INFECTIOUS DISEASE AND ITS PREVENTION. By SHIRLEY F. MURPHY, Medical Officer of Health to St. Pancras. [*Now Ready.*

CLEANSING STREETS AND WAYS IN THE METROPOLIS AND LARGE CITIES. By WILLIAM BOOTH SCOTT. [*Now Ready.*

LONDON WATER SUPPLY. By Colonel Sir FRANCIS BOLTON, C.E., assisted by the Engineers of the London Water Companies. [*Now Ready.*

FIRES AND FIRE BRIGADES. By Captain EYRE M. SHAW, C.B. *Illustrated.* [*Now Ready.*

ATHLETICS; or, PHYSICAL EXERCISE AND RECREATION. Part I. By Rev. E. WARRE, M.A., Eton College. *Illustrated.* [*Now Ready.*

ATHLETICS. Part II. By Hon. E. LYTTELTON, M.A., and GERARD F. COBB, M.A. [*Now Ready.*

DRESS, AND ITS RELATION TO HEALTH AND CLIMATE. By E. W. GODWIN, F.S.A. *Illustrated.* [*Now Ready.*

ACCIDENTAL INJURIES: THEIR RELIEF AND IMMEDIATE TREATMENT. HOW TO PREVENT ACCIDENTS BECOMING MORE SERIOUS. By JAMES CANTLIE, M.A., M.B., F.R.C.S. *Illustrated.* [*Now Ready.*

THE AMBULANCE. By Surgeon-Major EVATT, M.D., A.M.D. *Illustrated.* [*Now Ready.*

SCHOOLS OF ART: THEIR ORIGIN, HISTORY, WORK, AND INFLUENCE. By JOHN C. L. SPARKES, Principal of the National Art Training School, South Kensington. [*Now Ready.*

LONDON: WILLIAM CLOWES & SONS, LIMITED,
INTERNATIONAL HEALTH EXHIBITION, & 13, CHARING CROSS.

LONDON: PRINTED BY WILLIAM CLOWES AND SONS, LIMITED, STAMFORD STREET AND CHARING CROSS.