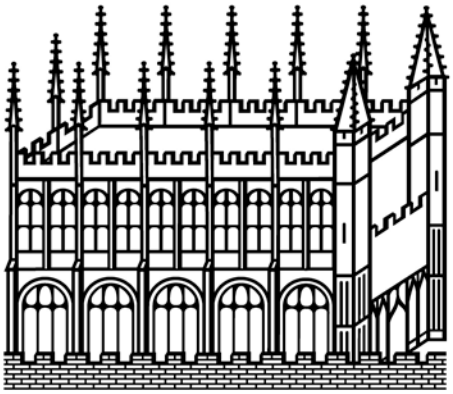

PITMAN'S COMMERCE SERIES

COMMODITIES OF COMMERCE

SLATER

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Edited by JAMES STEPHENSON, M.A., M.COM., B.SC.

COMMODITIES OF COMMERCE

BY

J. A. SLATER, B.A., LL.B. (Lond.)

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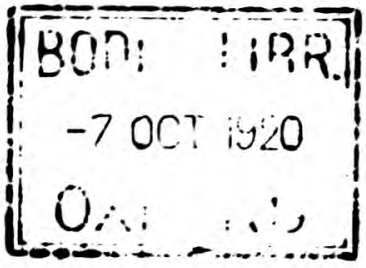

PREFACE

THE present volume is intended to serve as an introduction to the systematic study of the principal commodities which enter into the world's commerce. For a long time the rules which regulate the purchase and sale of goods have been included in the curriculum of most commercial schools under the heading of "Commercial Law," whilst the study of the actual commodities which constitute the basis of purchase and sale has been almost generally ignored.

"Commodities" as a subject of study does not claim the position of an independent science, but its sources are to be found in the sphere of natural science, technology, geography, statistics, and economics. A general knowledge of commodities should be distinguished from a specialized knowledge of commodities which treats in detail with certain branches of trade such as dyes and colours, textiles, drugs, etc. The general study of commodities embraces all these branches without entering into details, so that the person specially interested in a particular group of commodities should consult works of a more technical character. The present work, which is based on the Author's *Dictionary of the World's Commercial Products*, will serve its purpose if it leads the student to enter upon a more specialized study of this subject.

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CHAPTER I

INTRODUCTION

THE "Commodities of Commerce," as a subject of study, gives a clear description of goods which enter into the world's trade. Through the help of this study the trader is enabled to trace the origin of the commodities in which he deals, and to discern the various processes of manufacture which they undergo, the requisites of a good standard or quality, the nature of their chief constituents, their purity or impurity, and the methods for the prevention of their deterioration. In short, a knowledge of this subject should enable the trader to derive a practical and useful insight into the characteristics of his wares.

The study of commodities may be divided into three main divisions—

1. The characteristics of commodities in general.
2. A special knowledge of particular commodities.
3. The practical application of a knowledge of commodities.

The first two divisions of the subject will be dealt with in the following pages, whilst for the third division the only sphere for the proper conduct of the study is the warehouse or the shop.

The study of the commodities which enter into the world's trade offers excellent scope for the training of the senses. This is to be effected through the careful examination of the various raw materials which the student meets with in the course of business.

Thus, constant practice may enable a person to distinguish the qualities of certain commodities by gliding the fingers over the surface of the goods. Some substances are recognized by their smoothness or roughness (*e.g.*, textile materials), whilst others feel cold to the touch. It is the knowledge of the latter fact that enables genuine precious stones to be distinguished from glass imitations.

The sense of taste may be employed not only in the case of foodstuffs but also in regard to many other solid and liquid substances.

In the examination of some commodities the sense of smell is the absolute and deciding factor; for instance, the smell of coffee when roasted or of tobacco when burning.

A more uncommon method of examination is that by means of hearing, and in the trade in pure metals, glass, china, and earthenware, the quality of the goods is frequently determined by the sound they emit upon being thrown down or struck. Thus, porcelain emits a clear sound and earthenware a dull one.

Another matter which should be considered is the question of preserving commodities by means of a proper system of storage. In general, the principal requirements are dry, well-ventilated rooms. Articles such as seeds, herbal drugs, and certain chemical products should be safeguarded against light, the best way of preserving them being to enclose them in wooden boxes. If kept in hermetically sealed glass or tin vessels, seeds soon lose their power of germination.

On the other hand, commodities which tend to depreciate in quality by contact with the atmosphere should be kept in air-tight receptacles; otherwise they might lose their odour or undergo decomposition or disintegration. A low temperature is usually to be recommended for storage purposes, especially in the case of animal products, alcoholic liquors, syrups, extracts, etc. Moreover, the walls of the warehouse must be protected against the formation of mildew, saltpetre, etc., and attention must be paid to the escape of noxious gases where substances are subject to decomposition (*e.g.*, ammonia). Some articles are also subject to damage by vermin or moths (*e.g.*, cereals and furs).

It is not enough for the modern trader to know the art of buying and selling, but if he is to establish an enduring business connection he must also have a thorough knowledge of the commodities which

Russia.

important branch of mechanical industry, being even more important than the metallurgical industry, since they supply man with his clothing.

Cotton, flax, hemp, Manila-hemp, esparto grass.

	Cotton, flax, hemp, Manila-hemp, esparto grass.	important branch of mechanical industry, being even more important than the metallurgical industry, since they supply man with his clothing.	Russia.
	X. RUBBER. India-rubber and gutta-percha.	An elastic impermeable substance found in the milky juices of certain plants.	Brazil, Congo States, Bolivia, Ceylon, Farther India.
	XI. VEGETABLE OILS. Olive oil, sesame oil, palm oil, cotton-seed oil, linseed oil.	These are liquid, or easily become so when exposed to heat ; very combustible ; insoluble in water and alcohol, and leave a greasy stain upon paper.	Tropical and sub-tropical regions.
	XII. TIMBER.	This includes all kinds of felled and seasoned wood. Timber from the forests of the Temperate Zone is used chiefly in the building trade, whilst that of the Tropics is used for ornamental purposes.	United States, Canada, Russia, Scandinavia.
ANIMAL KINGDOM.	I. ANIMALS DERIVED FROM STOCK-REARING. Cattle, sheep, goat, horse, and pig.	These provide man with food and clothing, and are in most cases useful as beasts of burden.	Countries situated in the Temperate and warm Temperate Zones.
	II. PRODUCTS FROM RANCHING, STOCK-REARING, ETC. Hides and skins, livestock, meat ; wool, hair and bristles, furs, milk, butter and cheese ; poultry.	These are derived from the grasslands of the world, but are exported chiefly by the countries of the Southern Hemisphere.	Australia, New Zealand, British South Africa, India, Canada, and Denmark.
	III. PRODUCTS FROM THE INSECT WORLD. Silk and cochineal.	In recent times the products of the silk worm and of the cochineal have suffered from the competition of other artificially prepared goods.	France, Italy, Japan, and Mexico.
	IV. PRODUCTS FROM FISHERIES. Fish, crabs, mother-of-pearl, corals, etc.	The employment of steam fishing-vessels, the increase of population, the proportionately greater increased use of fish as food, have led to a revolution in this branch of production.	The three great centres of the world are the North Sea, the Banks of Newfoundland, and the Behring Sea

he is called upon to handle. In this way alone can he expect to become a good salesman.

TEST PAPER I

1. What is the aim of the study of the " Commodities of Commerce " as a subject of instruction ?

2. Into what three branches may the study of " Commodities " be divided ?

3. To what extent is it true to say that the study of " trade " is the study of commodities ?

4. After carefully examining the table inset between pages 2 and 3, state—

(1) The most convenient classification of commodities.

(2) The principal classes into which vegetable products are grouped.

5. Mention any precautions which should be taken in the warehousing of commodities.

CHAPTER II

CHARACTERISTICS OF COMMODITIES

A KNOWLEDGE of commodities, as has been already remarked, implies the consideration of the leading characteristics of the principal commercial products, the nature of the trade conducted in them, and the various uses to which they are put.

The Characteristics of a Commodity include a description of all the facts which help to establish its identity, and therefore the following particulars are requisite—

1. The *name* of the commodity (*i.e.*, the scientific name as well as the popular name).

(For example, the scientific name for blue crystals is sulphate of copper; for green crystals, sulphate of iron; for alum, sulphate of potash; and for bitter salts (or Epsom Salts), sulphate of magnesium.)

2. Whether the commodity is a manufactured or a natural product.

3. The source of origin of the commodity (in the case of natural products).

4. The method of extraction or of manufacture.

5. The most important characteristics and external features by which the commodity is distinguished from others.

6. The principal commercial characteristics and their distinguishing features.

7. The leading substitutes and adulterations, as well as the methods and means of recognizing them.

The Study of the Trade in any commodity should embrace the following—

1. The buying and selling prices of the goods.

2. The sources of supply.

(These include the chief depôts, warehousing centres, fairs, markets, seaports, and factories where the article may be best obtained.)

3. The most favourable period of purchase.

4. The usual quantities bought and the trade terms.

5. The manner, according to their nature, in which they have to be packed, marked, shipped, or warehoused.

(Some indication should also be given as to the use to which the article may be put.)

The distinguishing features of a commodity are both *external* and *internal.* As a rule, it is sufficient to describe the external features; to ascertain the internal features requires such knowledge and skill which, generally speaking, cannot be expected of a merchant. The knowledge of commodities is usually confined to a description of the raw materials. Among the most important characteristics of commodities are—

1. The state of cohesion.
2. The external shape and the internal structure.
3. The specific gravity.
4. Their behaviour in relation to light.
5. Their behaviour in relation to taste or smell.
6. Their microscopic behaviour.
7. Their chemical behaviour.

THE STATE OF COHESION.

In the world of bodies there are three states of cohesion: the solid, the liquid, and the gaseous.

To understand these terms we must keep in mind that all bodies consist of very small physical and indivisible parts—the molecules (*or atoms* in the case of certain chemical elements) held together, more or less firmly, by the force of cohesion.

The bodies whose parts can be separated from each other only with difficulty, that is, those in which the cohesion is great, are called *solid bodies.* With *liquid bodies* the cohesion is less; that is, the various parts may easily be separated from each other. In the case of *gaseous bodies* there does not appear to be any cohesion whatever—the various parts having the tendency rather to separate from each other (*i.e.*, expansion, tension, or elasticity).

EXTERNAL SHAPE AND INTERNAL STRUCTURE.

The forms in which mineral, inorganic, vegetable, and animal substances present themselves are very varied.

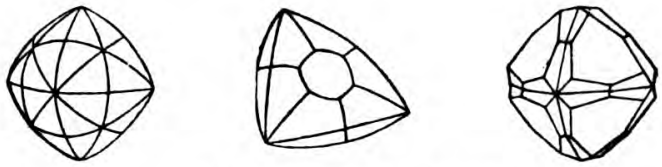
For instance, there are bodies with surfaces meeting at certain angles; these bodies are said to be crystallized since they consist of a number of crystals. Two surfaces of a crystal, in meeting, form an edge, and three or more surfaces, in meeting, form a corner. Crystals of different substances are shaped in a variety of geometric forms, but they can be classified into six great families according as to whether they have (1) nine, (2) seven, (3) five, (4) three, (5) one, or (6) no planes of symmetry respectively. Crystals in the sixth group, however, are symmetrical about a point. The planes of symmetry, when intersected, are called the axes of symmetry, and these all pass through the same

point, called the centre of the crystal. The subject dealing with the crystals of various compounds is an interesting one, and is known as crystallography.

It is characteristic of crystals that they may be cut easily along the main surfaces of the crystal, so that from a large crystal may be cut smaller crystals with bright surfaces.

A practical use of this knowledge is made in the working of diamonds, the great hardness of which entails a very tedious process of grinding. This work is materially shortened, however, by splitting or cleaving the stones between the layers.

If all the surfaces in a crystal are not completely formed, the bodies are said to be crystalline; where all trace of crystallization is absent they are known as amorphous or shapeless bodies.



CRYSTALS OF DIAMOND

In one of these structural forms are to be found all **mineral substances,** and some of them occur in all three forms. For instance, cane sugar is crystallized as sugar and amorphous as barley sugar or caramel. Carbon is crystalline as diamond or graphite, and amorphous as organic carbon.

Frequently these differences in the structure of bodies entail differences in their peculiarities. For instance, crystallized carbon in the shape of diamonds is the hardest body of all; it is transparent, colourless, of very great and peculiar brilliancy, a bad conductor of electricity and heat, and its specific gravity is 3·6. Carbon in the form of graphite is soft (a portion of the substance sticks to the fingers), of a greyish-black colour, with a metallic shine, a good conductor of electricity and heat, and has a specific gravity of 1·8 to 2·3. The amorphous organic carbon is likewise soft, and is usually of a dull black colour. It has the faculty of absorbing organic colouring matter and many other substances (*e.g.*, alkaloids and products of decomposition) from watery solutions, and for this reason it frequently serves as a discolouring or disinfecting medium. Its specific gravity is 1·2 to 1·8.

Phosphorous in the crystalline state is yellowish-white, similar to wax, opaque, soluble in carbon disulphide, and is very poisonous. It shines in the dark and ignites spontaneously in contact with air, so that it has to be kept continuously under water. Its specific gravity is 1·83. In the amorphous state it is brownish-red, easily pulverized, insoluble in carbon disulphide, and is non-poisonous; it does not shine in the dark, nor ignite spontaneously by contact with the air; its specific gravity is 2·25.

The existence of one and the same chemical substance in various external forms, as described in the above examples, is known as *allotrophy*, and the forms themselves are called allotrophic modifications.

The forms of **vegetable substances** are manifold, but in the study of commodities there is no need to enter into great detail. The various parts of a plant are the root, the stem, the leaves, the flower, and the fruit.

The root is that portion of a plant which is hidden under the soil and which serves to hold the plant in position and to nourish it. The roots vary considerably in regard to shape and consistency (fleshy, wooden, turnip-shaped, etc.), and must not be mistaken for parts of the stem which are frequently found under the soil, but which invariably have eyes or buds; whilst the genuine root is always free from such formations.

The part of the plant which rises up almost vertically is known as the stem in the case of herbs, the trunk in the case of trees, and the stalk in the case of flowers. The various parts of the stem proceeding from the outside towards the centre are—

(1) The *pith* in the centre which is soft and white;

(2) The *wood*, round the pith, which is hard; and

(3) The *bark* surrounding the wood, the outer surface of which is often green in colour.

In considering the leaves, we have to pay attention to their shape, the nature of the edge of the leaf, the arrangement of the veins and their hairyness, which is frequently a characteristic feature.

The flower of a plant is an expression which signifies the combination of organs which produce the seed. Generally speaking, these organs are leaves transformed in a peculiar manner. All plants, however, do not bear flowers, and according to this characteristic we distinguish—

(*a*) Flowering plants.
(*b*) Flowerless plants.

The flowering plants are the more highly organized, and propagate themselves by seed. In the case of the lower plants—the flowerless plants (mushrooms, mosses, lichens)—propagation takes place by means of spores.

The Animal Kingdom furnishes commodities in three principal forms, viz.—

1. Whole animals.
2. Parts of the animal body.
3. Animal products.

WHOLE ANIMALS enter into commerce either living or dead.

Living.—Animals for riding or draught purposes, for slaughtering, milking, or for their wool; and some edible creatures (oysters).

Dead.—Fish, game, and various insects, such as cochineal and Spanish flies.

PARTS OF THE ANIMAL BODY which form commodities of commerce are: meat, hides, horns, hoofs, claws, bones, tortoise shells, teeth, fins, quills, bristles, feathers, hair, wool, and scales.

ANIMAL PRODUCTS forming commodities of commerce are: fats, wax, honey, milk, manure, silk, musk, etc.

The conclusion as to the internal structure of a body may frequently be arrived at from the appearance of the cross section after it has been broken. Such a cross section, however, must not be taken in the direction in which the body can be split. There are various kinds of fractures—

1. The smooth fracture, where the surface is an even or plane surface (*e.g.*, asphalt).
2. The uneven fracture which shows an irregular or rough surface (*e.g.*, loaf sugar).
3. The splintery fracture (*e.g.*, some limestones and crude wax).
4. The shell-like fracture, where the appearance of the broken surface reminds one of a shell (*e.g.*, glass, resin, sugar candy).
5. The earthy fracture, where the fractured surface shows numerous small mounds (*e.g.*, chalk, ochre, chocolate).
6. The fibrous fracture, especially in plants, where the ends of fibres rise above the fractured surface (*e.g.*, cane).
7. The hooky fracture is exhibited by bodies which bend before breaking, in which case the ends of fibres are bent over into the shape of little hooks (*e.g.*, wrought iron).

SPECIFIC GRAVITY.

Owing to the attraction of the earth, all bodies will fall unless supported. The force which causes or tends to cause this motion is known as the weight of a body, and this varies slightly at different points on the earth's surface, being greater at the poles than at places near the equator. Solids and liquids having the same volume have not necessarily the same weight. In order readily to compare the weights of equal volumes of substances, the comparison in each case is made with water at 4° C. (*i.e.*, Centigrade). The specific gravity of a solid or a liquid is the ratio of its weight to

that of an equal volume of water at 4° C. As solids and liquids expand when heated, the specific gravity of any substance diminishes as the temperature is increased. As regards gases, the specific gravity is the ratio of the weight of a volume of the gas, as 0° C. and subjected to a barometric pressure of 780 m.m. (*i.e.*, a standard atmospheric pressure), to that of an equal volume of hydrogen under the same conditions of temperature and pressure. Sometimes air at 0° C. at standard atmospheric pressure is taken as the standard of comparison, and in Physics the specific gravities of gases with water at 4° C. as the standard of comparison.

For instance, the specific gravity of silver is 10·5, and that of gold is 19·5; this means that a volume of silver weighs 10½ times more than the same volume of water, whilst the volume of gold is 19½ times heavier than the same volume of water.

A cubic centimetre of water of 4° C. weighs 1 gramme. This weight has been adopted as the unit of the scientific system of weights. A thousand cubic centimetres of water, therefore, weigh 1,000 grammes, or 1 kilogramme. Having a specific gravity of 10·5, 1 cubic centimetre of silver therefore weighs 10·5 grammes; 1 cubic decimetre (*i.e.*, 1,000 cubic centimetres) weighs 10·5 kilogrammes; 1 cubic centimetre of gold weighs 19·5 grammes, and 1 cubic decimetre of gold weighs 19·5 kilogrammes. The specific gravity of pure alcohol is ·0800, and 1 litre of alcohol therefore weighs 800 grammes.

In many cases the specific gravity is an important characteristic of a commodity. It is used, for instance, in establishing the genuineness of precious stones, metals, metallic alloys, and for ascertaining the commercial values of many liquids, such as spirits, acids, salt, oil, milk, etc. For this reason it is necessary to become acquainted with the methods of calculating specific gravities.

The establishment of the specific gravity is based upon the Law of Archimedes, which says that a body immersed into a liquid loses thereby as much of its weight as is weighed by the volume of liquid displaced by it. Thus, if a solid be wholly immersed the loss of weight is equal to the weight of an equal volume of water.

As an auxiliary for ascertaining the specific gravity of solid bodies, the hydrostatic scale is generally used. The hydrometer is used for estimating the specific gravity of liquids. That for finding the specific gravity of milk is known as the lactometer.

BEHAVIOUR IN RELATION TO LIGHT.

The Optical Relation, or relation to the light, is determined by the colour, the brilliancy, the transparency, and the nature of the surface.

COLOUR.—In general, colour does not possess great value as far as a means for judging commodities is concerned. Apart from the fact that colour is very uneven and variable, it must be pointed out that the faculty of distinguishing colours is purely subjective or personal, and for that reason it is of importance who makes the observation as regards colours. Moreover, some people—the so-called colour-blind—possess no capacity for distinguishing widely different colours, as, for instance, blue and yellow, red and green.

This colour-blindness is more frequent amongst men than amongst women, and is traceable to a disease of the optical nerves. In order to understand this peculiar phenomenon, it has to be taken into consideration that the white light consists of seven fundamental or simple colours (*i.e.*, red, orange, yellow, green, light blue, dark blue, and violet—the rainbow colours, or colours of the spectrum). Blue and orange–yellow, green and red, violet and yellow, are so-called complementary colours when, in uniting into white light, they supplement each other. Green and red light are, as is generally known, used for signalling purposes, and for this reason all persons engaged in the railway services should be examined for colour blindness.

According to whether they show metallic brilliancy or not, colours are distinguished as metallic and non-metallic.

The exact definition of a metallic colour is difficult. As a way out of this difficulty the colour is described by combining the name of the metal with that of the colour, as: copper red, golden yellow, brass yellow, silver white, leaden grey, steel grey.

For non-metallic colours, certain examples are used in their description which show the colour in question in especial purity, or in a peculiar shade, as, for instance, in white, snowy white; in red, carmine red, blood red; in yellow, lemon yellow, sulphur yellow, orange yellow; in green, emerald green, grass green, olive green; in blue, sky blue, indigo blue, Prussian blue; in brown, chestnut brown, liver brown; in grey, ash grey, or, in combination with other colours, bluish grey, greenish grey, brownish grey, and yellowish grey.

If a colour is approaching another colour, it is said to shade into that colour.

BRILLIANCY.—In judging of brilliancy, we have to note its strength and nature. According to the strength of the brilliancy, bodies are divided into—

1. Very brilliant.
2. Brilliant.
3. Slightly brilliant.
4. Shimmering.
5. Dull.

According to the nature of the brilliancy we distinguish between—

1. Metallic brilliancy.
2. Diamond brilliancy.
3. Glass brilliancy.
4. Fat or oil brilliancy.
5. Mother-of-pearl brilliancy.
6. Silk brilliancy.

TRANSPARENCY is that property of bodies which admits of the passage of light through them. According to the grade of the transparency we distinguish—

1. *Transparent* bodies (*i.e.*, such bodies as let the light through to such an extent that an object behind them can be distinguished plainly with all its contours : atmosphere, glass, mountain crystal).

2. *Translucent* bodies, which admit the passage of light only imperfectly; that is, bodies behind them appear indistinct and without well-defined contours (*e.g.*, thin paper, ground glass).

3. *Opaque* or non-transparent bodies, which do not permit of the passage of light through them. Where such bodies are opaque only when in thick layers but are translucent when in thin layers, they are said to be translucent on the edges.

The colour of the surface of a body is frequently different from the colour of its constituents. When anything brittle is drawn across a rough surface, a mark results from the abrasion. The mark produced is usually lighter than the ordinary colour of the surface of the body. Where the body is of a plastic nature this mark is of a shiny appearance, and in some instances is of a peculiar colour (*e.g.*, bright copper colour in the case of indigo). Hence the nature of the mark resulting on the surface of a commodity may assist in determining the kind of goods. For instance, bituminous coal and ordinary coal may easily be distinguished by the

mark which is shown by them when scratched. Bituminous coal always leaves a brown mark, whilst ordinary coal leaves a black one.

In testing alloys of metal this method is often applied in order to judge the alloy of precious metal from the colour of the mark.

BEHAVIOUR IN RELATION TO TASTE OR SMELL.

The difference in the quality of goods may often be determined by the sense of taste or of smell. If such tests are undertaken by competent persons they may be of great value.

In the wine, tea, coffee, and tobacco trades the qualities are always determined through the senses of taste and of smell.

Spices, too, are judged in the same way. Both methods, however, are closely connected with each other, and frequently a person thinks he is tasting when in reality he is exercising his sense of smell.

BEHAVIOUR UNDER THE MICROSCOPE.

An excellent means of determining the nature of some commodities, and especially of gaining an insight into internal construction is the use of the microscope, and the student who desires to dip deeply into the study of commodities with any chance of success must make himself familiar with its use.

In order to understand the use of a microscope, it is necessary to know the essential conditions under which an object becomes clearly visible.

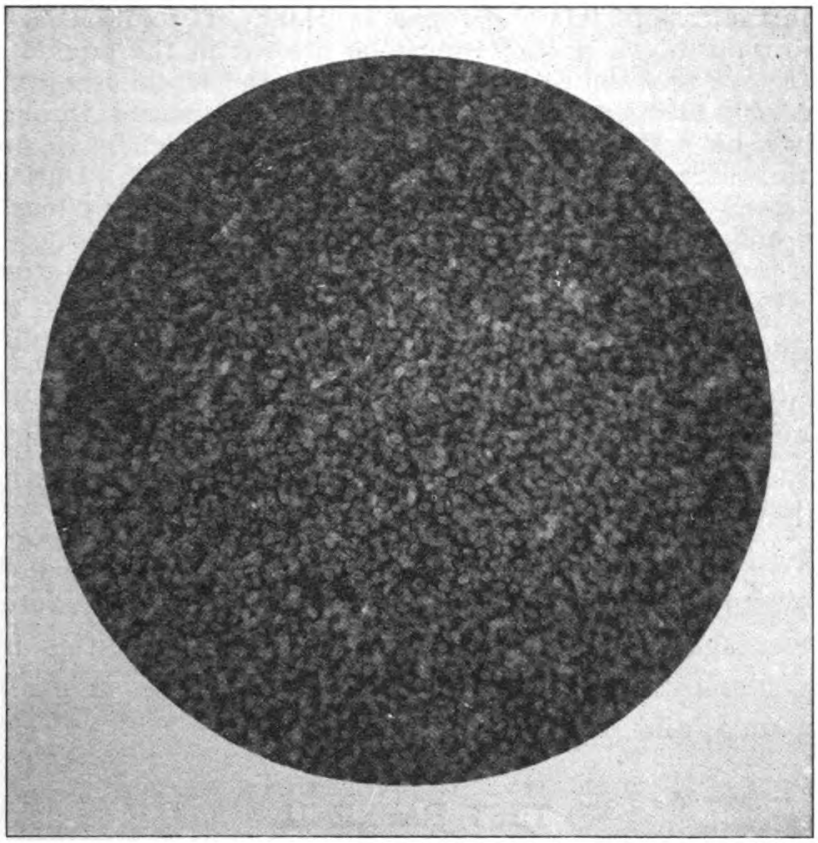
Only those objects are visible which radiate light, and this light enters the eyes. The seat of vision is the retina of the eye, which is an enlargement of the visual nerves proceeding from the brain. On this retina the images of the visible objects are produced, these only appearing distinct if the impressions are of sufficient duration, brightness, and size. The smaller the visible object, the smaller, of course, will be the picture thrown on the retina. If the body is very small, it is brought as near as possible to the eye, for in this manner the picture thrown on the retina becomes larger. However, if the object is brought nearer to the eye than the distance of clear visibility, which, in the case of the normal eye, is 10 in., it does not increase its visibility; on the contrary, the image becomes blurred. If the object is not too small, it can be examined to advantage by means of the simple microscope or the magnifying glass.

CHEMICAL RELATIONS.

Although a merchant will but rarely be in a position to acquire all that knowledge and ability which would enable him to conduct

the chemical analysis of goods—this remaining the professional sphere of the analytical chemist—there are yet a number of easily applied methods which, in many cases, may yield valuable information.

In this category have to be mentioned bodies which act in a certain way on certain vegetable colours, or towards some media of dissolution, or in certain temperatures.



POLLEN GRAINS FROM THE TINY STAMENS OF THE OAK CATKINS, MAGNIFIED

The numerous grains shown here would find ample room spread on the head of a pin

Certain vegetable colours, as, for instance, the blue litmus, change their colour in a conspicuous manner if acted upon by certain bodies. For example, blue litmus, if acted upon by acids, becomes red, and if acted upon by alkalis it turns blue again. It is possible, therefore, to place a substance tested by litmus immediately into one category or another (*i.e.*, acids or alkalis).

If a substance does not change the colour of litmus, it is called neutral.

Generally, the test is carried out by immersing blotting paper into either blue or red tincture of litmus and drying these pieces of blotting paper, whereupon they are used by immersing them into the liquids to be tested.

Frequently the nature of commodities may be determined by their behaviour in media of solution (*e.g.*, water, alcohol, ether, benzol, turpentine).

The first medium of solution which one would generally apply, except in the case of fats and resins, is water. If solution has taken place, no undissolved particles must be present in the liquid.

If there are any undissolved particles in the liquid, they may be separated by filtration. The liquid which has passed through the filter must be perfectly clear. Those portions which have not dissolved in water may be treated with diluted acids. During this process, gases frequently develop, which may be either odourless or odorous, and these may escape with effervescence.

Fats, resins, and oils can be dissolved in alcohol, ether, turpentine, benzol, etc.

In order to examine substances in their relation to heat, a small fraction of the substance is laid on a piece of sheet platinum and heated over a spirit or gas flame. It must then be observed whether the body evaporates, melts, expands, gives off vapour, turns into charcoal, or whether it is altogether consumed.

Finally, in a few cases, by the application of liquids or solutions of a known percentage of acid or alkali, a merchant may determine the percentage of valuable substances in commodities by the process of analysing by measure, as, for instance, in examining vinegar, soda, and potash.

TEST PAPER II

1. How is the identity of a commodity usually established ?
2. Enumerate the most important characteristics of a commodity.
3. In the study of the trade in any commodity, what are the chief points which merit consideration ?
4. Say what you know of the external shape and internal structure of any commodity with which you are acquainted.
5. Name the various types of fractures found in particular bodies.
6. Explain what is meant by " specific gravity." Why is it of importance in the study of commodities ?
7. Mention any points which should be considered in determining the colour of a commodity.
8. In what way may the senses be applied in estimating the value and quality of certain commodities ?
9. Account for the use of the microscope in the examination of commodities.

CHAPTER III

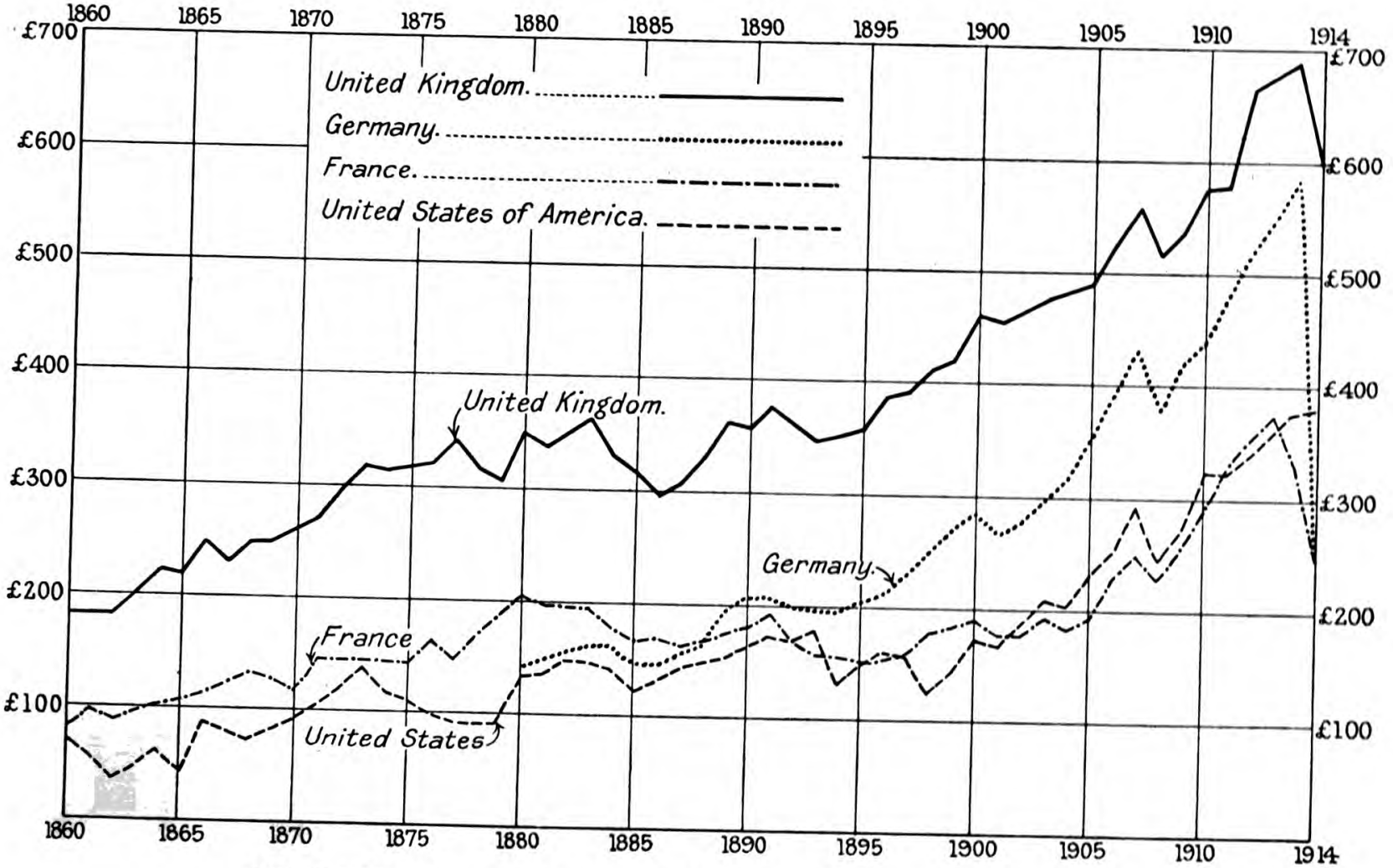
PRINCIPAL COMMODITIES OF THE WORLD'S TRADE

THE principal place among the commodities which enter into the world's commerce is occupied by material goods (*i.e.*, commodities proper). For the year 1913 the total value of the turnover of the goods which was effected in the import and export trade of the countries of the world amounted to £6,700 millions. This sum, which may be regarded as the value of the world's foreign trade, was shared as to one half by the four largest commercial nations of the earth (*i.e.*, Great Britain with £1,125 millions, Germany with £825 millions, the United States of America with £650 millions, and France with £625 millions). The other half was distributed among the remaining countries of the world.

Large as the above sum turned over in the import and export trade may appear, it was yet far behind the total amount of the goods which were exchanged in the home trade of the various countries, which cannot even be estimated.

As regards the merchandise circulating in international trade, its total value may be estimated at £3,250 millions annually; that is, a little less than half of the total import and export of all countries. It must be remembered that, in the statistics of the world's trade, goods are counted at least twice; (that is, as the export of one country and as the import of another), and in some cases even more frequently, since many goods imported in certain trades are afterwards re-exported.

Of especial importance among the commodities of the world's commerce are *foodstuffs* which are imported by countries having a population in excess of what they can feed by their own produce, and also raw materials which are required for the purposes of manufacture. Many important industries are now located far from the places where the requisite raw materials are produced, and are, therefore, dependent upon the importation of the raw materials as well as, in many cases, of the foodstuffs for the feeding of their workmen. Thus, the foreign trade of Great Britain is characterized in a high degree by the importation of raw materials



IMPORTS OF THE LEADING COMMERCIAL COUNTRIES FROM 1860 TO 1914
(IN MILLIONS OF POUNDS STERLING)

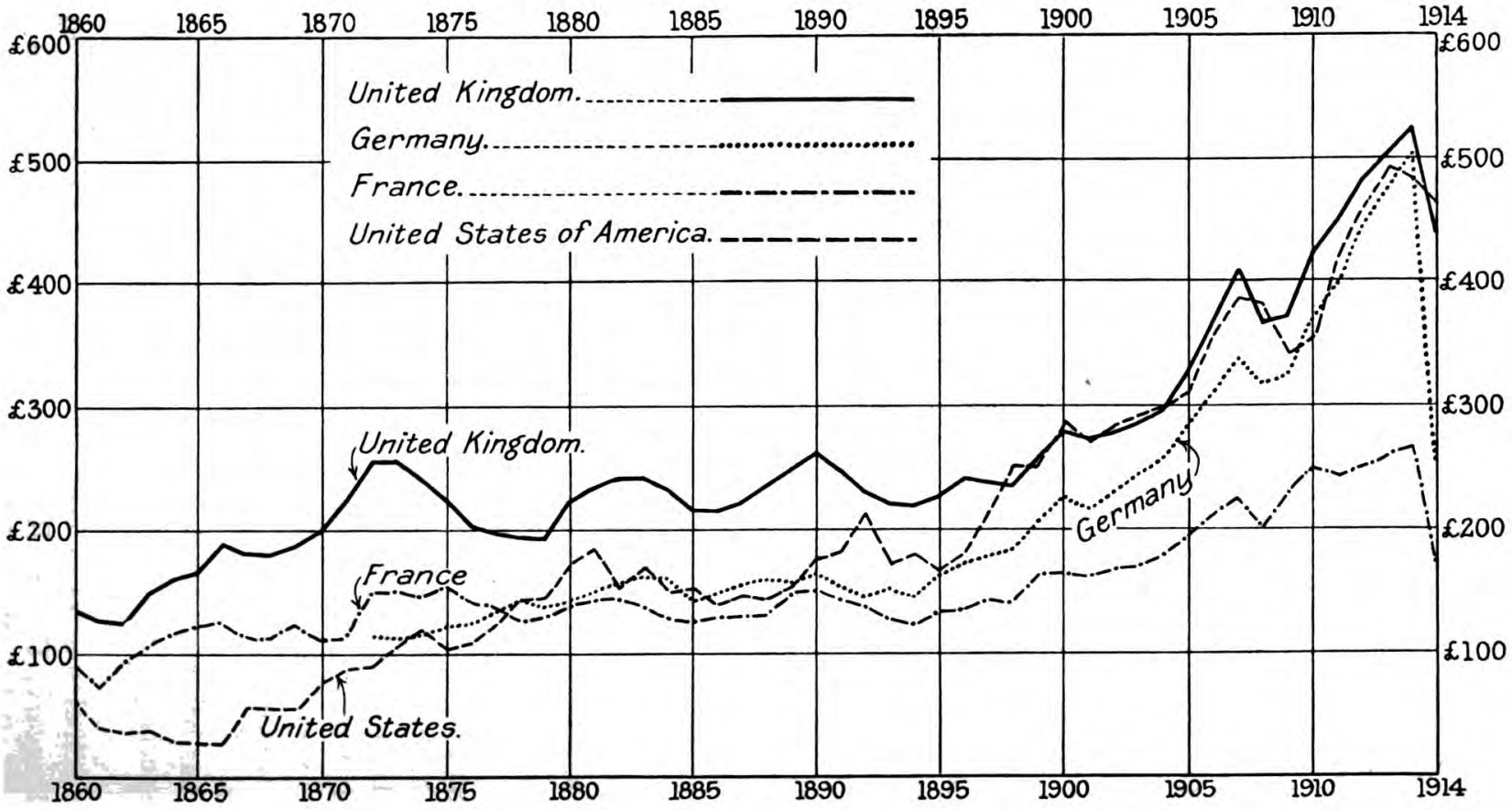
and foodstuffs, and the exportation of manufactured goods. Likewise the importation of Germany consisted as to more than one-half of raw materials and partly manufactured articles required for her industries, and more than a quarter of foodstuffs. On the contrary, in the case of Russia, about two-thirds of the total exports consisted of foodstuffs, whilst the remainder for the most part took the form of raw or half-manufactured goods. The United States of America was also engaged chiefly in the export of foodstuffs and raw materials, but also, in addition, manufactured goods of all kinds in considerable quantities; thus her imports of foreign manufactures were, in consequence, relatively small.

In this connection it is only possible to discuss a few of the most important of the commodities which help to constitute the world's commerce.

Among the articles of food, the first place is taken by cereals, which, according to the turnover at the present time, is the most important commodity of commerce. About a tenth part of the total production of the earth in wheat and flour is dealt with in international trade, and its average annual bulk before the War was estimated at about 63 million tons. The large suppliers of wheat are Russia, United States, Argentina, Roumania, India, and Canada, which flood the markets of the grain-importing countries with an annual amount of more than 30 million tons, divided as to one-third to England and a little more than one-third to Germany, Holland, and Belgium. In spite of technical difficulties, the international trade in livestock, meat, tinned meat, and extracts of meat has developed to such an extent in recent times that in 1913 it amounted to about £150 millions. The United States of America, Argentina, Uruguay, Canada, Denmark, and Holland were the principal exporting countries for these articles, whereas England and Germany were the principal importers.

Sugar has become an article of commerce of the highest importance, especially since beet entered as a competitor with cane sugar.

The principal sources of beet sugar production were Germany, Austria-Hungary, France, Russia, Belgium, and Holland; and of cane sugar, Cuba, Porto Rico, Java, the Philippines, Hawaii,



EXPORTS OF THE LEADING COMMERCIAL COUNTRIES FROM 1860 TO 1914
(IN MILLIONS OF POUNDS STERLING)

Mauritius, etc. The most important sugar-importing countries are Great Britain and the United States of America.

In regard to coffee, almost the entire production of the world, which amounts to about 20 million cwt., is dealt with in international trade. As an exporting country, Brazil excels by far all other areas of production; whilst the greater share of the consumption of coffee is borne by the United States of America, and Germany.

Tea, cocoa, tobacco, and wine are likewise prominent commodities of the world's commerce.

In the world's trade in raw materials for manufacture, cotton undoubtedly holds the most significant position. Of the total production of cotton, amounting annually to about 4 million tons, it is estimated that not much less than 3 million tons are dealt with on the world markets. The principal countries of production and of exportation of cotton are the United States of America, India, Egypt, China, Brazil, etc.; whereas Great Britain, Germany, and the other European countries are the principal areas of importation. The greatest consumption of cotton takes place in the United States; then follow Great Britain and Germany as the principal consuming countries. Wool, also, has become a very important article of the world trade, largely owing to the fact that its production in the chief civilized countries was unable to keep pace with the development of their woollen manufactures. Great quantities of raw wool are now imported from Australia, New Zealand, Argentina, and British South Africa into the principal areas of consumption, such as England, Germany, France, and the United States. Other raw materials used in the textile industry and likewise handled in large quantities are silk, flax, hemp, and jute. More important than these, for the purposes of international trade, however, have become the raw materials of certain other manufactures, such, for instance, as *coal*, the leading exporter of which is Great Britain; *iron ore*—imported chiefly by Germany and Great Britain from various countries, especially Spain; *pig iron*—of which Great Britain furnishes the principal supplies; also several other *metals*, and *oil*, *timber*, etc. Moreover, there is a large number of *manufactured articles* of the most varied kinds which figure largely as commodities in the trade returns of the different countries.

TEST PAPER III

1. Explain the meaning of the expression " Commodities Proper."
2. Enumerate the four principal countries which participate in the world's trade.
3. How does it happen that commodities are counted twice in the statistics of the world's trade ?
4. Point out peculiar features which characterize the import and export trade of England, Germany, Russia, and the United States.
5. Which, in your opinion, is the most important article which enters into the world's trade ? Give reasons for your answer.
6. State the principal sources from which the world's supply of wheat is drawn, and mention the most important markets for its distribution.
7. Why does sugar hold such an important position in the world market ?
8. Give a list of the six leading raw materials which enter into commerce.

SECTION II

THE MINERAL KINGDOM

CHAPTER I

GENERAL SURVEY

THE surface of the land is covered in most parts by a layer of small particles of broken-up rocks known as soil. This is the most important part of the earth's surface, as far as man is concerned, since it supports vegetable life, which in its turn supports animals, and thus renders the earth habitable by mankind. For the cultivation of the soil, the variety and composition of the rocks and their distribution over the earth's surface are of paramount importance.

The earth's interior provides man with numerous forms of mineral wealth, although the most useful are unevenly distributed. For this reason those activities which are dependent upon their existence can only rarely and to a small extent be carried on at a distance from the source of their production. Where iron and coal are found together in abundance, their existence tends to give rise to densely populated industrial districts, as, for instance, the cotton district of Lancashire, the woollen district of Yorkshire, the neighbourhood of Liege in Belgium, and the manufacturing district of the Lower Rhine. The nature of the building materials determines the character and appearance of the houses and other constructions found in different localities. The supply of other minerals permits of the manufacture of glass, china, and earthenware, or the cutting of precious stones. The discovery of precious metals exercises a considerable influence upon the economic character of a country. Thus, in those quarters of the globe where gold has been worked on a large scale, peculiar characteristics of industrial life have developed. The deposits of silver, the production of which is more regular than that of gold, also lead to increased industrial enterprise, although not to the same extent as gold-mining. The whole landscape frequently assumes a different

aspect owing to the exploitation of rich mineral deposits, as, for instance, in the iron and coal-mining districts, and in the vicinity of oil springs and of copper mines.

TABLE OF ELEMENTS
WITH THEIR SYMBOLS AND ATOMIC WEIGHTS

No.	Name of Element.	Symbol.	Atomic Weight.	No.	Name of Element.	Symbol.	Atomic Weight.
1	Silver (Argentum)	Ag	107·9	42	Nitrogen	N	14·0
2	Aluminium	Al	27·1	43	Natrium	Na	23·0
3	Argon	Ar	39·9	44	Niobium	Nb	93·5
4	Arsenicum	As	75·0	45	Neodymium	Nd	144·3
5	Gold (Aurum)	Au	197·2	46	Neon	Ne	20·0
6	Boron	B	11·0	47	Nickel	Ni	58·7
7	Barium	Ba	137·4	48	Oxygen	O	16·0
8	Beryllium	Be	9·1	49	Osmium	Os	190·9
9	Bismuth	Bi	208·0	50	Phosphorus	P	31·0
10	Bromine	Br	79·2	51	Lead (Plumbum)	Pb	207·1
11	Carbon	C	12·0	52	Palladium	Pd	106·7
12	Calcium	Ca	40·1	53	Potassium	Pr	140·6
13	Cadmium	Cd	112·4	54	Platinum	Pt	195·0
14	Cerium	Ce	140·2	55	Radium	Ra	226·4
15	Chlorine	Cl	35·4	56	Rubidium	Rb	85·4
16	Cobalt	Co	59·0	57	Rhodium	Rh	102·9
17	Chromium	Cr	52·0	58	Ruthenium	Ru	101·7
18	Cacsium	Cs	132·8	59	Sulphur	S	32·1
19	Copper (Cuprum)	Cu	63·6	60	Samarium	Sa	150·4
20	Didymium	Dy	162·5	61	Antimony	Sb	120·2
21	Erbium	Er	167·4	62	Scandium	Sc	44·1
22	Europium	Eu	152·0	63	Selenium	Se	79·2
23	Fluorine	F	19·0	64	Silicon	Si	28·3
24	Iron (Ferrum)	Fe	55·8	65	Tin (Stannum)	Sn	119·0
25	Gallium	Ga	69·9	66	Strontium	Sr	87·6
26	Gadolinium	Gd	157·3	67	Tantalum	Ta	181·0
27	Germanium	Ge	72·5	68	Terbium	Tb	159·2
28	Hydrogen	H	1·0	69	Tellurium	Te	127·5
29	Helium	He	4·0	70	Thorium	Th	232·4
30	Mercury (Hydrargyrium)	Hg	200·0	71	Titanium	Ti	48·1
				72	Thallium	Tl	204·0
31	Indium	In	114·8	73	Thulium	Tu	168·5
32	Iridium	Ir	193·1	74	Uranium	U	238·5
33	Iodine	I	126·9	75	Vanadium	V	51·2
34	Kalium	K	39·1	76	Wolfram	W	184·0
35	Kriptoro	Kr	83·0	77	Xenon	X	130·7
36	Lanthanum	La	139·0	78	Yttrium	Y	89·0
37	Lithium	Li	7·0	79	Ytterbium (Neoyterbium)	Yb	172·0
38	Lutetium	Lu	174·0				
39	Magnesium	Mg	24·3	80	Zinc	Zn	65·4
40	Manganese	Mn	54·9	81	Zirconium	Zr	90·6
41	Molybdenum	Mo	96·0				

Moreover, mineral wealth influences transport in so far that, owing to its great weight, it necessitates improved means of

communication, and it constitutes the basis for the carrying on of many auxiliary industries.

The mineral kingdom—with water and atmosphere, which must be accounted inorganic substances—includes 81 elements which have been determined with certainty by chemistry. Of these a portion only serve in the production of the various commodities of commerce which are drawn from the vegetable and animal kingdoms. In the table on page 22, the chemical elements are shown, together with their scientific symbols and atomic weights. The chemical symbol of each element at the same time represents its atomic weight, or the proportion of weight in which it combines with other elements. An atom is the smallest portion of an element which can no longer be chemically divided, whilst a molecule is the smallest portion of a body which is incapable of being divided mechanically. Thus we speak of a molecule of water, by which is meant the chemical formula H_2O; that is, the combination of two atoms of hydrogen with one atom of oxygen, or two portions of the former with sixteen weight portions of the latter. The chemical affinity (*i.e.*, the tendency of bodies to combine) varies greatly, and frequently changes with the atmosphere so that higher temperatures often bring about combinations between two bodies which in a cold temperature do not re-act upon each other. The reverse case is also frequently met with.

Amongst metals, gold and platinum excel by their comparative lack of chemical affinity with other elements; for this reason they are found mostly in their natural state and brilliancy. In this characteristic they are only surpassed by five colourless gases which constitute about $\frac{3}{4}$ per cent. of the atmosphere. These have only been discovered within recent times, and have been separated from each other in an ingenious manner. These are the so-called precious gases—argon, helium, cripton, neon, and xenon. On the other hand, the elements oxygen, hydrogen, nitrogen, silicium, aluminium, calcium, and iron are noted for being the principal constituents of the land masses of the earth, as well as of the atmosphere and the oceans.

TEST PAPER IV

1. " The discovery of precious metals exercises a considerable influence upon the economic character of a country." Discuss this statement.
2. What is the difference in meaning between an " atom " and a " molecule"?
3. Why are gold and platinum usually found in a natural state ?
4. Enumerate the so-called precious gases.
5. In what two classes may the elements be divided ?

CHAPTER II

NON-METALLIC MINERALS

FROM this group of minerals, carbon in its various modes of occurrence, and use, is of the greatest significance in the study of commodities.

(*a*) PURE OR ALMOST PURE CARBON.

1. Diamond. (Fr. *Diamant*, Ger. *Diamant*, Sp. *Diamante*.)

Diamond is the most valuable of all precious stones, and consists of pure crystallized carbon. Under a high temperature it may, therefore, be burnt to carbonic acid.

It is the natural form of crystallized carbon, and is well known by its peculiar lustre. The colourless stones are generally the most prized, though a rare colouring may give a fictitious value to those of inferior quality. Much depends upon the cutting, and this highly skilled industry is carried on principally at Amsterdam.

The diamond is harder than any other mineral, and this hardness is one of its most distinguishing features. Only a diamond will readily scratch a ruby or a sapphire. In spite of its hardness, however, it is exceedingly brittle. Its specific gravity is 3·5. Since the chemical composition of this precious stone is so well known, many efforts have been made to produce artificial diamonds, but little success has attended the experiments owing to the expense and the danger involved. The first water in diamonds means the greatest purity and perfection of their complexion, which ought to be that of the purest water. When they fall short of this perfection, they are said to be of the second or third water.

India, Brazil, and South Africa, especially the last named, are the principal diamond producing countries, and it is believed that the precious stones exist in Australia. The Indian diamond in lustre is higher than Brazilian stones, but few are now found in India, the site of the Golconda mines having been built over and lost.

An imperfect variety of diamond is bort, or boart, which is not capable of being used as an ornament, but is employed as an abrading agent when ground. Another variety is carbonado, black and opaque, found only in Brazil. Its density is less than that of the crystallized diamond, but its hardness is greater. Hence it is used for mounting in the steel heads of rotary diamond drills for rock-boring.

2. Graphite or Plumbago. (Fr. *Graphite,* Ger. *Graphit,* Sp. *Grafito.*)

Though blacklead is the popular name for graphite, no lead enters into the composition of this mineral. It is one of the forms in which carbon occurs native. It is of a greyish-black colour with a metallic lead-like lustre and a greasy touch. Graphite is found in many parts of the world, especially Ceylon, Siberia, Bohemia, and Bavaria, but some of the best is obtained in Cumberland. The last is valuable on account of its fine grain, in the manufacture of lead pencils. Graphite is also used for the manufacture of crucibles, for giving a polished surface to cast-iron, and for counteracting friction.

(*b*) MINERAL FUEL.

This group of non-metallic substances consists of those minerals which are constituted essentially of carbon and hydrogen. They burn in the open air usually with a highly smoky flame, and are chiefly of use as sources of light and heat.

1. Coal. (Fr. *Charbon de terre houille,* Ger. *Kohle,* Sp. *Carbon.*) Coal is the most important of all fuels. It consists mainly of carbon with small quantities of oxygen, hydrogen, and nitrogen. There is also, in addition, a little mineral matter or ash, but this should not exceed 10 per cent. of the whole. Coal occurs in beds, the beds varying in thickness from a few inches to several feet, and often extending over a considerable area. It is of vegetable origin, most probably being the remains of vast forests of the carboniferous period. Owing to the enormous pressure of the superincumbent matter, the chemical composition of the original vegetable has undergone a complete change, and the vegetable structure has been completely destroyed. The principal varieties of coal are as follows—

(*a*) CANNEL OR PARROT COAL is that which is believed to have been formed from decomposing vegetable matter in water, and


BRITISH
COAL FIELDS
Key
Exposed Coal Measures.
Covered Coal Measures.
Pre-carboniferous Rocks.
Submarine Coal Workings.
NORTH SEA
IRISH SEA
ENGLISH CHANNEL
Bristol Channel
Cardigan Bay
LONDON
Berwick
Maryport
Whitehaven
Barrow
Preston
LIVERPOOL
DUBLIN
Anglesey
Wrexham
Nottingham
LEICESTERSHIRE
WARWICKSHIRE
Coventry
Birmingham
Whitby
York
Humber
The Wash
Swansea
Cardiff
Bristol
Barnstaple
Bridgwater
Frome
Plymouth
Ayr
Ballycastle
Belfast
Isle of Man
Firth of Forth

has little or no lustre. It is highly bituminous and yields a large quantity of gas or paraffin oil, according as it is distilled at a high or a low red heat.

(*b*) COMMON OR HOUSEHOLD COAL includes many sub-varieties, such as coking coal, cherry coal, smithy coal, splint coal, all of which are bituminous, but less so than cannel coal. Some of them are regularly used for making gas. Coking coal cakes or fuses together when burning; cherry coal is soft and breaks into small cubes, and like most of the varieties of bituminous coal, except cannel, it has a resinous or shining lustre. Splint coal is hard and slatey, and when of good quality gives off great heat in burning.

(*c*) BROWN COAL OR LIGNITE is a substance of which large deposits occur in Saxony, Bohemia and the Rhine Provinces, although it is widely distributed throughout the Northern Hemisphere. This mineral, which often retains its woody structure in a nearly perfect state, is of less value than ordinary coal, but still it is of great importance as a fuel to the districts where it is found.

(*d*) ANTHRACITE is coal which has almost all its volatile or bituminous matter driven off by contact with igneous rocks. It contains 95 per cent. of carbon, is hard, dense, and often lustrous, and does not soil the fingers when touched. The alteration of the vegetable matter has gone further in this kind than in ordinary coal. Anthracite is difficult to ignite, but it burns with little flame or smoke, and gives out an intense heat. It is particularly useful for marine engines, the smelting of ore, and other metallurgical operations. The chief supplies are obtained in South Wales and the United States.

Coal is found in most parts of the world, but is chiefly worked in the United States, United Kingdom, and Germany. The great beds of India, China, and Canada are practically untouched. The English export trade has increased with amazing rapidity during the last 50 years, and alarm has been felt as to the probable exhaustion of the supplies. It has, however, been confidently asserted that there is still sufficient to meet all ordinary demands for at least 200 years.

While the output of coal per man in the United States and Germany increases, in the United Kingdom there was before the war a small but actual diminution. Coal is comparatively easily won in the United States, and coal cutting machinery is much more

freely used there. The world's annual production of coal in million tons is as follows—

United States	477
United Kingdom	260
Germany	172
France	40
Russia	26
Belgium	23
Other Countries	102
TOTAL	1,100,000,000 tons
UNITED KINGDOM	260,000,000 ,,
BRITISH DOMINIONS	50,000,000 ,,

PERSONS EMPLOYED—

United Kingdom	1,069,000
United States	723,000
Germany	611,000
France	199,000
Belgium	146,000

The following table gives the annual output from the different coalfields of the British Isles before the war, together with the percentages of the total output—

TABLE OF BRITISH COALFIELDS AND THEIR OUTPUT

(*In thousand tons*)

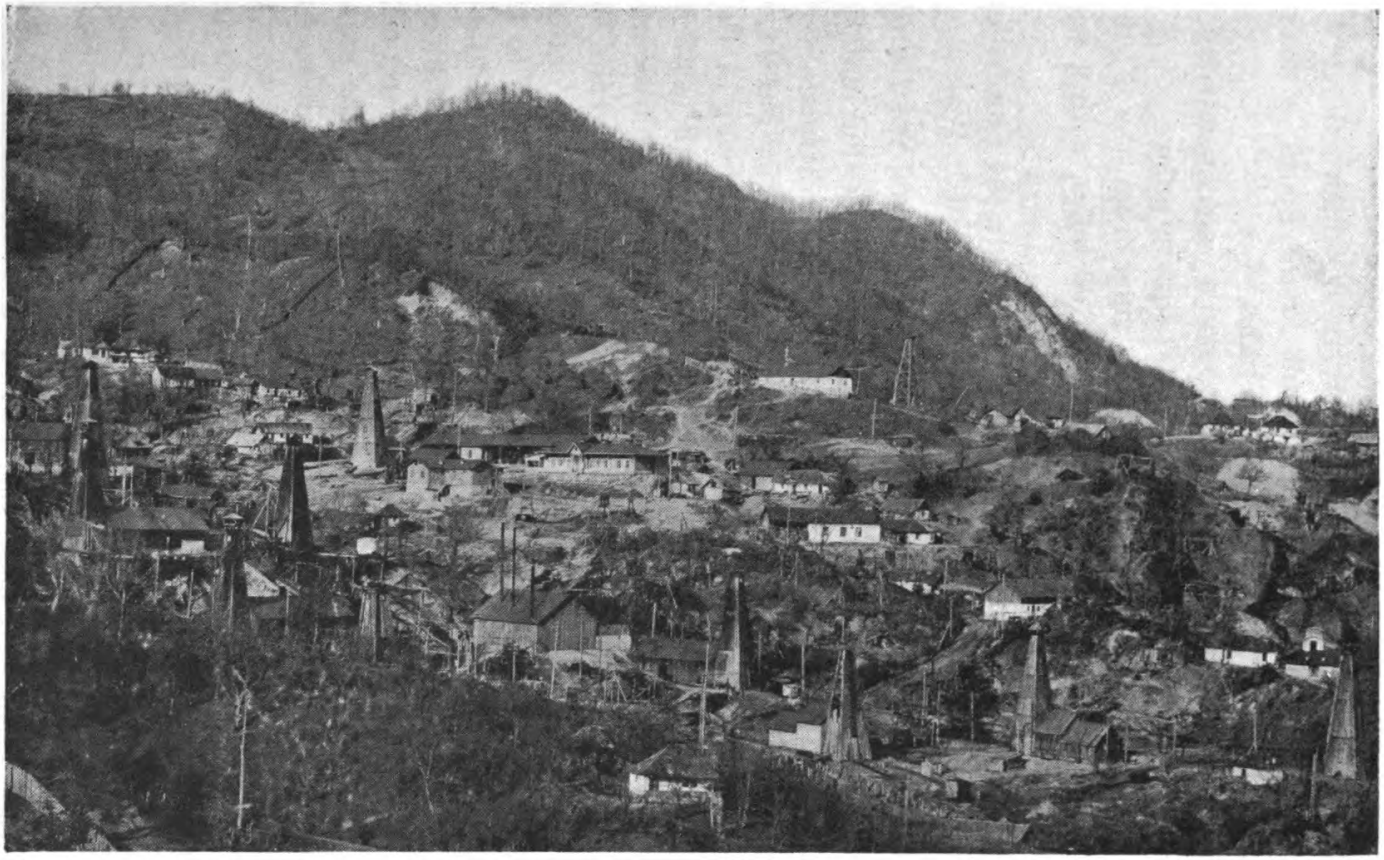
		Per cent.
Yorkshire Coalfields	67,920 =	25
Northern	56,401 =	21
South Wales	50,200 =	18·2
Scottish	41,718 =	15·4
Lancashire and Cheshire	23,980 =	8·7
Midland	23,232 =	8·4
North Wales Coalfields	3,443 =	1·2
Irish Coalfields	84 =	·4
Other Coalfields	4,896 =	1·7
	271,874 =	100

The chief coalfields of the British Isles are—

(1) THE NORTHERN COALFIELD, which extends from the Croquet to the Tees, and embraces an area of 1,000 square miles.

(2) THE MIDLAND COALFIELD, which is situated in the counties of Derby, Nottingham, and York.

(3) THE SOUTH WALES COALFIELD, which stretches from Pembrokeshire to Monmouthshire in the east, and is about 73 miles long by 16 miles wide. It is the only coalfield in Great Britain in which anthracite is found.



BUSTENARI—ROUMANIA'S FAMOUS OIL REGION

(4) THE LANCASHIRE COALFIELD, which has an area of about 200 square miles, and is divided from the Midland Coalfield by the Pennine Range.

(5) THE SOUTH STAFFORDSHIRE COALFIELD, which extends from Rugeley in the North to near Harborne in the South, a distance of 22 miles, with a width of about 6 miles.

(6) THE NORTH STAFFORDSHIRE COALFIELD, which underlies the Pottery District, and has an area of 100 square miles.

(7) THE SCOTTISH COALFIELD, which runs from the Firth of Forth to the Firth of Clyde, a distance of 90 miles, with a width of about 30 miles.

Other British coalfields of lesser importance are the Cumberland, Warwickshire, Leicestershire, Shropshire, and North Wales.

2. Petroleum. (Fr. *Pétrole*, Ger. *Petroleum, Bergöl*, Sp. *Petróleo.*)

This is also called rock oil. It is a thick oil consisting mainly of a mixture of paraffins and hydrocarbons of the benzene series. It is found chiefly in the United States, Canada, and Russia, the most celebrated springs in the last named country being at Baku. It oozes from the ground in natural springs, though additional supplies are obtained by boring and pumping. Petroleum is supposed to be the result of the natural distillation of coal and shale taking place beneath the surface of the earth. When it is obtained in its natural condition it is unfit for use, but is subjected to fractional distillation. The products thus derived are of three different kinds. The first consists of light oils, such as benzoline, which are highly inflammable and dangerous as illuminants. The second, or refined petroleum, are the illuminating oils, especially the paraffin oil of commerce. The third are the heavy oils used as lubricants. Petroleum has been and is still used to a certain extent as a fuel for steam boilers. The by-products obtained from petroleum are extremely numerous, including lampblack, dyes, carbolic acid, aniline, saccharine, oil of mirbane, vaseline, etc.

3. Naphtha. (Fr. *Napthe*, Ger. *Naphtha, Steinöl Erdöl*, Sp. *Nafta.*)

The name "naphtha" was once applied very widely to liquid hydrocarbons exuding from the ground, but now it signifies the inflammable distillates of crude mineral oils and coal-tar. Paraffin and petroleum are not now included in the list. But the term does include the distillates of india-rubber, bones, wood, peat, etc.

The forms of naphtha are very different in their chemical construction, but all are highly inflammable and exceedingly volatile. Their uses in the arts are also widely different, but it is mainly as solvents that they are of commercial importance. The use of one kind of naphtha, viz., benzoline, for small lamps has disappeared owing to the cheap production of paraffin.

4. Paraffin. (Fr. *Paraffine*, Ger. *Paraffin*, Sp. *Parafina.*)

Paraffins are a series of hydrocarbons, occurring as gases, liquids, or solids, according to the proportion of carbon present in them. They are prepared by the destructive distillation of bituminous shale, or as a by-product in the manufacture of coal gas. The shale is broken into small pieces and heated in retorts, when inflammable gases, oil, and water distil over. The oil is collected and subjected to a second distillation, from which the paraffin oil of commerce is obtained. The heavier oil obtained is used for lubricating purposes. The residue on this second distillation is solid paraffin, and when purified forms the paraffin wax of commerce. Solid paraffin is an odourless and tasteless substance, nearly as hard as beeswax, melting at a temperature of 100° to 140° F. Its principal use is for making candles, a certain amount of stearin being added to the paraffin. It is also used in the manufacture of lucifer matches as a substitute for sulphur, and it can be utilized as a substitute for wax in modelling flowers and fruits. The natural oils of America and Russia, sometimes included under paraffins, are more commonly known as petroleum.

5. Ozokerit. (Fr. *Ozokérite cire minérale*, Ger. *Ozokerit, Erdwachs*, Sp. *Ozokerita, cera mineral.*)

This is a kind of earth-wax or solid paraffin found naturally in Galicia and Moldavia. The best kind is green or yellow in colour and transparent, the inferior being dark brown and almost opaque. It is soft in character and can easily be kneaded in the hand. Pure ozokerit has a high melting point and excellent illuminating power. It is, in consequence, much employed for the manufacture of candles.

(*c*) MISCELLANEOUS.

1. Amber (Fr. *Ambre*, Ger. *Bernstein*, Sp. *Ambar.*)

This is the fossil resinous exudation of certain extinct species of conifers. Hard and brittle, it varies in colour from pale yellow

to reddish-brown. It is generally transparent, though sometimes it is found clouded and opaque. Amber is mainly used for the manufacture of personal ornaments, especially pipe mouth-pieces, beads, etc., and is much prized in the East. Though found in small quantities in various parts of the world, the greater portion of the market supply is derived from the shores of the Baltic, the annual value of the amber obtained there being about £70,000.

2. Asphalt. (Fr. *Asphalte, goudron-mineral,* Ger. *Asphalt,* Sp. *Asfalto.*)

This is a composition of pitch, earthy, elastic, and compact, used for paving roadways, for cementing roofs, and as a lining for cisterns and iron pipes. It is a fossil hydrocarbon, and is obtained from mines, being found either on the surface or embedded in the earth. Immense quantities are imported into Great Britain, mainly from Trinidad. It is the principal ingredient in Japan varnish. Asphalt is supposed to be a product of the distillation of carbonized vegetable matter by the action of subterranean heat and moisture in the absence of atmospheric air.

3. Sulphur. (Fr. *Soufre,* Ger. *Schwefel,* Sp. *Azufre.*)

Sulphur is one of the most important of the non-metallic elements. It occurs free in certain volcanic districts, particularly in Sicily and Iceland, where it appears as yellow transparent crystals. In combination with many metals it forms sulphides, which constitute the ores from which the metals themselves are ordinarily obtained. The chief of these sulphides are galena and blende. The principal supplies of sulphur come from Sicily, where the element is found in beds of blue clay. In order to extract it, the native substance is piled in a heap and loosely covered with earth. Heat is applied, a portion of the sulphur is ignited, and the remainder, being melted, trickles down to the bottom of the heap, where it is collected. In this form it is exported, and when it arrives in this country it is subjected to distillation, the vapour being condensed in chambers. If the vapour is quickly cooled below its melting point, it solidifies in the form of a fine crystalline powder known as flowers of sulphur. If then the flowers of sulphur are greatly heated, the substance melts and may be cast into sticks. This is the brimstone or roll sulphur of commerce.

Sulphur is a yellow, brittle, solid substance, with very little taste

or smell, insoluble in water, but soluble in bisulphide of carbon, oil of turpentine, benzol, and heated alcohol. At a temperature of 150° C. it melts and forms an amber-coloured thick fluid, darkening as the temperature rises until it becomes like thick treacle. It burns, when heated to 260° C., with a pale blue flame, and emits a suffocating odour. At a temperature of 440° it boils and gives off red-coloured vapour.

In its various forms, sulphur is used for a considerable number of purposes, chief among them being the manufacture of sulphuric acid, gunpowder, lucifer matches, vulcanite, and sulphurous acid.

TEST PAPER V

1. Enumerate some of the chief forms assumed by carbon.
2. Name some of the main characteristics of a diamond. Which are the most important diamond-producing areas of the world ?
3. What are the principal varieties of coal ? In what districts do they respectively occur ?
4. Distinguish anthracite and bituminous coal, and say to what uses they are each put.
5. Compare England, France, Germany, and the United States as coal producing areas.
6. Describe the nature and uses of petroleum. What are the chief by-products derived from this article ?
7. Write short notes on naphtha, paraffin, and ozokerit.
8. Whence do we obtain our chief supplies of amber, asphalt, and sulphur ?

CHAPTER III

LIGHT METALS

METALS may be classified according to weight into light and heavy. The specific gravity of the former is mostly below 3, that of the latter over 5. None of the light metals occurs in a pure state, and but few are themselves consumed in large quantities. In most cases it is their natural salts or those manufactured from them which account for their value. Light metals may be divided into—

1. Alkali metals.
2. Metals of the alkaline earths.
3. Earth metals.

ALKALI METALS.

There are five alkaline metals, viz., potassium, sodium, lithium, rubidium, and caesium; and closely allied to these as regards the behaviour of its combinations—ammonium.

Lithium, rubidium, and caesium are comparatively rare metals, generally resembling sodium and potassium.

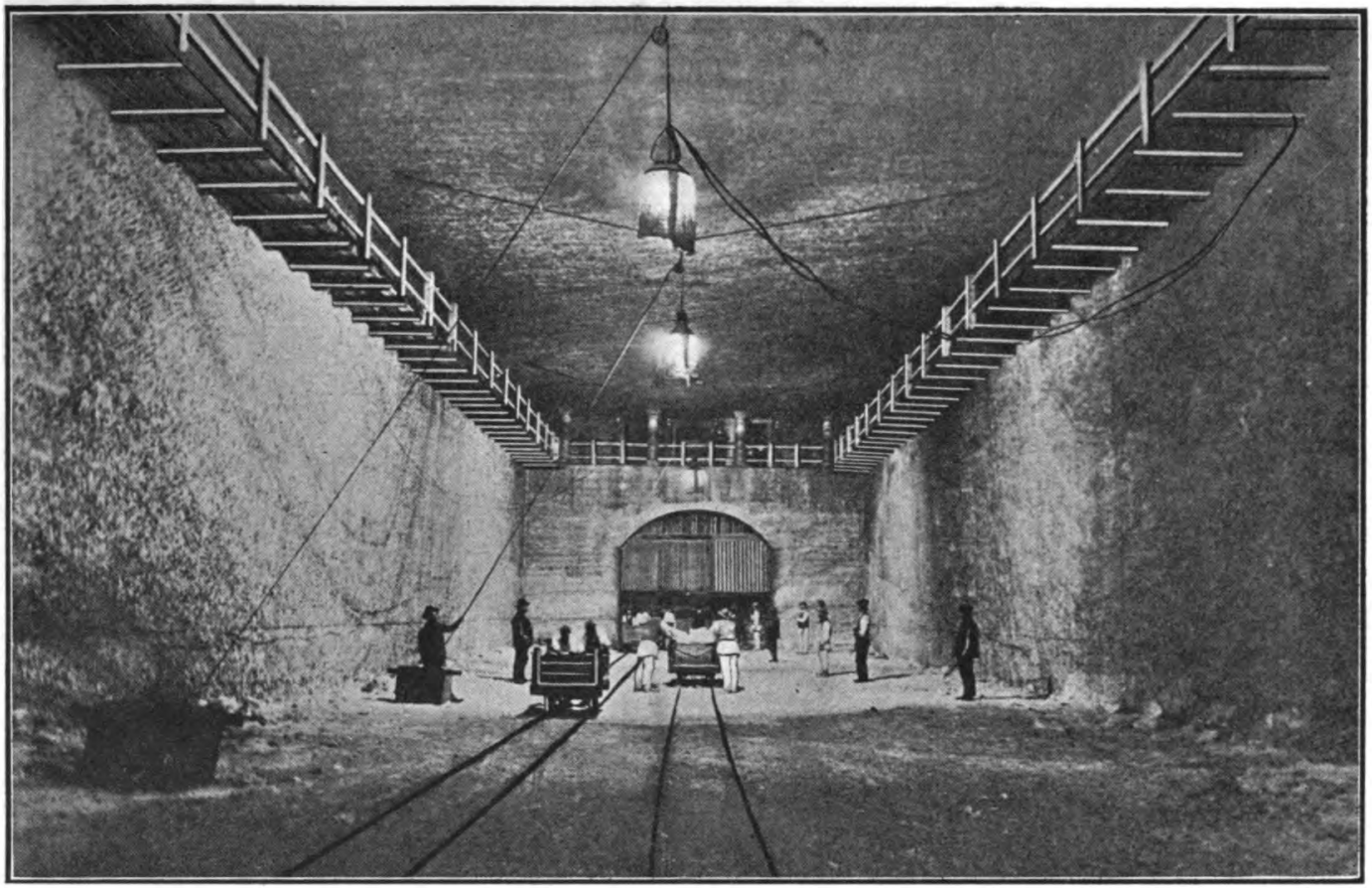
Sodium is the most widely distributed of the metals of the alkalies. It occurs in many compounds, such as common salt, caustic soda, bicarbonate of soda, etc.

Potassium is of a bluish white colour and has a strong metallic lustre. Its specific gravity is ·865, and when thrown upon water it floats and abstracts the oxygen from the water, while the liberated hydrogen takes fire. When heated, it burns with a blue flame.

We shall now deal with those alkaline salts which occur in fairly large quantities—

1. Salt. (Fr. *Sel*, Ger. *Salz*, Sp. *Sal.*)

This is the universal condiment, generally known as common salt, to distinguish it from the large body of other substances known to chemists as salts. Salt occurs in sea-water and the supplies of some countries are still largely obtained by the evaporation of sea-water. For others, the great natural beds of salt found in many parts are better and more serviceable. The largest



INTERIOR OF SALT MINE AT SLANICU, ROUMANIA

This famous mine has been worked since the time of the Romans

deposits of rock salt are found in the mines of Wieliczka, in Galicia. This rock salt is of a brownish colour, owing to the presence of a small quantity of peroxide of iron, and requires treatment before it is fitted for general use. In England, enormous supplies are obtained from the brine springs of Cheshire. The brine is pumped up and evaporated. If the brine is boiled down quickly, the salt separates into small crystals and forms the best table salt. By slow boiling large crystals are formed, and the coarse grained salt is obtained which is most suitable for curing. Bay salt is the name of the salt evaporated from sea-water. Salt has a specific gravity of 2·15. Besides its common domestic uses, salt is of the utmost importance in the manufacture of soda, hydrochloric acid, and soap. It is also much employed for filling the pipes of freezing machines.

2. Nitre. (Fr. *Nitre*, Ger. *Salpeter*, Sp. *Nitro, salitre.*)

This is also commonly known as nitrate of potash and saltpetre. Nitre is a white salt occurring either in the form of prismatic crystals or as a crystalline powder. It is found naturally as an incrustation on the surface of the soil of tropical countries, especially in Bengal and Oude; and it is prepared artificially by the action of nitric acid upon potash. In France, nitre is prepared from animal refuse—hides, entrails, etc. The animal matter, mixed with lime rubbish and ashes, is exposed to the air and kept moist with stable drainage. The greater portion, however, of the nitre of commerce is made from Chilian nitrate of soda by double decomposition. Nitre has a cooling saline taste, and dissolves readily in water. It contains a large proportion of oxygen and burns very readily and rapidly. It is a very important ingredient in the manufacture of gunpowder, fireworks, etc. It is also used in the preparation of sulphuric and nitric acids. Medicinally, it is employed for numerous purposes, especially in cases of rheumatism and sore throat.

Cubic nitre, or nitrate of soda, is sometimes known as Chili saltpetre. It occurs as an incrustation of the soil in Bolivia, Peru, and Chili, and derives its name from the cube-like form of its crystals. It is a white salt-like nitre, and the properties of the two substances are much the same. But cubic nitre is unsuitable for the manufacture of gunpowder. It is, however, of great value as a manure.

3. Glauber's Salt. (Fr. *Sel de Glauber*, Ger. *Glaubersalz schwefelsaures Natrium*, Sp. *Sal de Glauber.*)

Glauber's salt is sulphate of soda formed of compact, white, massive crystals, which effervesce rapidly. The powder has a bitter and saltish taste, and enters into the constitution of several mineral waters, such as those at Carlsbad and Cheltenham. It is also found in certain lakes in the United States. Glauber's salt is prepared from common salt and sulphuric acid, for the purpose of being used in the manufacture of carbonate of soda. For medicinal purposes a purer preparation is required, and carbonate of lime must be added. It is employed medicinally in cases of fever and inflammation.

4. Borax. (Fr. and Ger. *Borax*, Sp. *Atincar, borax.*)

Borax is a compound of boracic acid and soda. It is used as a flux for metals, and enters into the composition of some of the coloured glass pastes made in imitation of gems. In the arts and manufactures, it is used for glazing glass, enamel, and porcelain, but its greatest use is to facilitate the soldering of the more precious metals. It is also an ingredient of various toilet articles and in recent years it has been much employed in the preservation of meats. Borax was formerly imported in its crude state from India, but it also occurs native in various parts of South America.

METALS OF THE ALKALINE EARTHS.

This group comprises calcium, with a specific gravity of 1·6 and a melting point of 760°; strontium, with a specific gravity of 2·5; barium, with a specific gravity of 3·6, and magnesium.

1. Calcium. (Fr. *Calcium*, Ger. *Calcium*, Sp. *Calcio.*)

The metal present in chalk, stucco, and various compounds of lime. It is very widely distributed throughout the globe, though never found pure. It can be most easily prepared by passing an electric current through fused chloride of calcium, the metal then separating from the compound. Calcium is pale yellow in colour, and can be rolled or hammered into very thin sheets or plates. Its specific gravity is 1·578. Though of no commercial use alone, the compounds of calcium are very valuable. The oxide forms lime and, when water is added, slaked lime. The sulphide is

employed in the manufacture of luminous paint, whilst the sulphate is the chief constituent of gypsum.

2. Strontium. (Fr. and Ger. *Strontium*, Sp. *Estroncio.*)

This is a metallic element resembling calcium in its chemical properties. It occurs as a constituent in the minerals celestine and stronianite found in Scotland, especially in Argyllshire. It is a yellowish coloured substance, and tarnishes rapidly on exposure to the atmosphere. Several of its compounds are valuable in chemistry, and nitrate of strontia is used in the manufacture of fireworks. It burns with a characteristic red flame.

3. Barium. (Fr. *Baryte*, Ger. *Barium, Baryt*, Sp. *Bario.*)

This is the metal present in heavy spar (sulphate of baryta) and baryta. Barium is one of the so-called alkaline earths, and as yet it has only been obtained as a powder which is yellowish in colour. Its principal use is in the preparation of oxygen, though in the arts it is often employed for adulterating white paints. The carbonate of barium is employed as a pigment, and in the manufacture of certain kinds of glass.

4. Magnesium. (Fr. *Magnésium*, Ger. *Magnesium*, Sp. *Magnesio.*)

This is a metal usually grouped with the metals of the alkaline earths, but having many properties resembling those of zinc. It is obtained by fusing chloride of magnesium, one of the main constituents of sea-water, with sodium. It is brilliantly white and resembles silver in appearance. When drawn out into wire or ribbon it burns with a brilliant light, and is largely used for photography in dark places.

EARTH METALS.

In this group we have about twenty different metals, most of them rare, of which only two, that is, aluminium and berillium, occur in important quantities. They do not all correspond in meaning to the definition of light metals, as, for instance, thallium, with a specific gravity of 11·8; thorium, 11·0; cerium, 6·7; Indium, 7·4; and gallium, 5·9. We shall here consider the first only.

Aluminium. (Fr. *Aluminium*, Ger. *Aluminium*, Sp. *Aluminio.*)

This is a white metal found in clay, felspar, slate, and other rocks. The most convenient source of aluminium is bauxite, a clay found at

Les Baux (France), which has replaced the cryolite obtained from Greenland. The metal is extremely light—its specific gravity being only 2·5—and takes a high polish. It is used as an alloy with most metals, but will not amalgamate with mercury. It is especially valuable in the manufacture of mathematical and optical instruments, where lightness and durability are essential qualities. It is also useful for castings. Its great value has now been recognized in the building of ships and boats, particularly torpedo boats, and owing to its present cheapness it will certainly be applied more and more to metal manufactures.

Aluminium bronze is a compound of copper and aluminium—the latter to the extent of about 10 per cent.—and is much used in the manufacture of cheap jewellery.

Kaolin. (Fr. *Kaolin*, Ger. *Kaolin, Porzellanerde*, Sp. *Caolin.*)

Kaolin is a very pure white clay, and is commonly known as China clay. Its name is derived from Kauling, a hill in China, where the substance was first found, and near which it was first used in the manufacture of porcelain. Kaolin is the result of the decomposition of felspar, water replacing the potash and part of the silica. On account of its purity, it is valuable in the manufacture of china and the finest kind of porcelain, and it is also used by paper makers. For a long period the only supplies were obtained from China and Japan, but in 1775 kaolin was discovered in Cornwall. The chief British supplies are now derived from that county, about 30,000 tons being used annually. There are deposits near Limoges, in France, and in Nebraska, in the United States.

Two important industries which are based upon earth metals should here be mentioned, viz., pottery and glass.

Pottery. (Fr. *Poterie*, Ger. *Steinzeug, irdene Ware*, Sp. *Vidriado vasijeria.*)

The local marl, together with the excellent fire-clay found in the Staffordshire coal measures, has always been of value to the potter, but some of his best clays come from Cornwall, Dorsetshire, and Devonshire. Felspar is brought from Canada, Norway, Sweden, France, and other parts of the Continent, while the China stone, flint, bones, lead, borax, colouring matters, and metallic salts all come from a distance. The great extension of the

industry in Staffordshire seems to have depended most upon the possession of abundance of good coal, the presence of a population trained in some measure to work of this kind, and the excellent provision for transport by railway and canal.

Glass. (Fr. *Verre*, Ger. *Glas*, Sp. *Vidrio.*)

This is the mineral product, generally transparent, formed by the fusion of certain siliceous and alkaline matters, the mixtures varying according to the requirements of the substance. The principal kinds of glass are the following: (1) Flint glass, sometimes called crystal or crystal glass, composed of potash, silica, and oxide of lead; (2) window glass, including crown, sheet, and plate, composed of soda, silica and lime; (3) Bohemian glass, composed of potash, silica, and lime; and (4) bottle glass, or common glass, composed of soda, silica, and lime, with small quantities of potash, soda, iron, manganese, and baryta. It is to the presence of iron that the green colour of the last is due, and in the manufacture of all the best kinds the greatest care must be taken to have all the materials absolutely free from iron, or the green colour must be neutralized by adding oxide of manganese. The materials required for the manufacture of glass are first carefully mixed, and then strongly heated in special pots and furnaces, expressly made for the purpose. The after processes depend upon many circumstances, and can only be detailed in works specially dealing with the subject. Glass is largely made in England, especially at St. Helens, in Lancashire, but there is a considerable import as well as export trade in this substance. The best sand for glass-making is obtained from France and Belgium.

TEST PAPER VI

1. Into what classes may metals be divided for the sake of convenience?
2. What is meant by "light metals"? Into what groups may they be divided?
3. Enumerate the most important alkaline metals, and say how they are to be distinguished from other groups of metals.
4. What are the chief methods of producing salt? For what purposes is this article chiefly used?
5. State some of the uses of nitre.
6. Mention the chief uses of aluminium, and say what you know of its characteristics.
7. Write short notes on the following—

   Light metals; kaolin; glass; pottery.

CHAPTER IV

HEAVY METALS

THE heavy metals constitute the second largest and by far the most important group of mineral substances, to which the term " metals " has been applied since the beginning of the nineteenth century. The most valuable, such as gold, silver, copper, tin, and iron, were already known among the earliest peoples of antiquity. Even to the present day they possess more or less the most outstanding characteristics of the whole group, such as a high specific gravity, metallic lustre, opaqueness, malleability, and ductility, which enable them to be drawn out in the form of wire. The most marked physical characteristic of heavy metals is their metallic lustre, and the readiness with which they conduct heat and electricity. The metallic lustre is the name given to the peculiar brilliancy of a polished metallic surface. All metals when polished show this lustre. Metals differ from each other in conductivity or the power of conducting heat and electricity; but they are, as a rule, much better conductors than non-metallic substances. In other physical properties, metals show great variety in fusibility, ranging from mercury, which is liquid at ordinary temperatures, and only freezes at about 40° F., to platinum, which requires the highest temperature we can produce for its fusion. Some metals are very hard, others very soft. As examples among heavy metals we may compare the hardness of iron with that of silver, and that of lead.

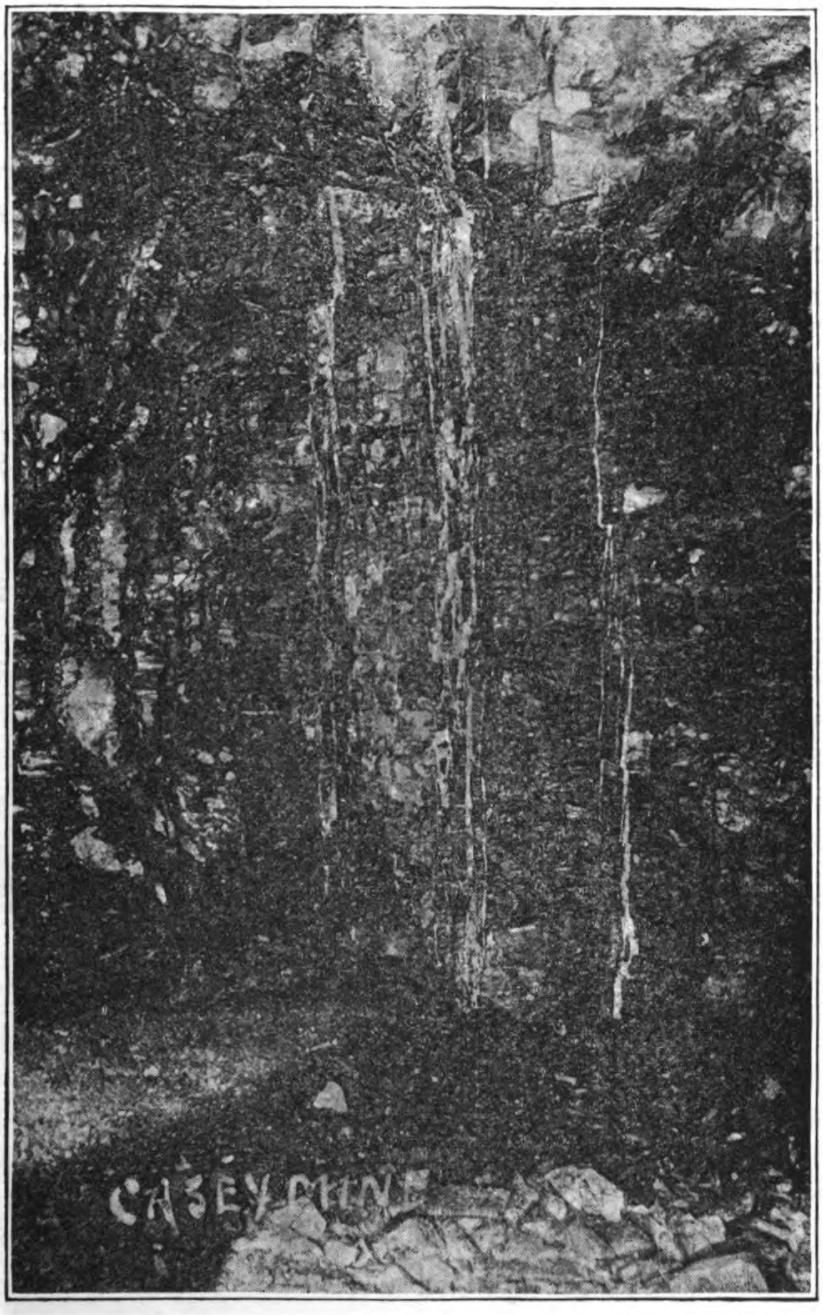
1. Gold. (Fr. *Or*, Ger. *Reines, Gold*, Sp. *Oro.*)

This is the beautiful yellow precious metal, which is largely imported as ore, bullion, and coin, and which is employed for coinage, ornaments, plate, and jewellery. It was formerly obtained in small quantities in various parts of Europe, in South America, and in India; but for the last half century Australia and California have supplied the demands of the world, and the valley of the Yukon, in Alaska, promises to be a very plentiful field in the immediate future. Gold is always found mixed with other minerals, and takes the form of grains or nuggets. As the former, it is found in alluvial deposits derived from crystalline rocks. In order to

separate it, the sand or gravel is carefully washed in running water, the lighter gravel being washed away and the heavier gravel and the gold left behind. In California and Australia the metal is found interspersed through quartz. The rock is crushed by machinery, and treated with mercury or fused with lead, by which means the pure gold is separated. With the exception of platinum and iridium, gold is the heaviest metal in general use, its specific gravity being 19·3. It is the most malleable and ductile of metals; it can be beaten into leaves so fine that light can be transmitted through them, and drawn into wire so fine that 15 grains will give a length of more than 2,000 yds. It is too soft to be worked alone, and when in use it is found necessary to have an alloy of copper or silver. Pure gold is said to be of the fineness of 24 carats. For the gold coinage of Great Britain an alloy of 22 parts gold and 2 parts copper is used, and this is said to be 22 carat gold. In jewellery, there are various standards, the most usual being 18, 15, and 9 carats. The metal is not attacked by any ordinary acid—sulphuric, hydrochloric,or nitric—but it dissolves readily in aqua regia, a mixture of the two last mentioned acids. As it does not combine with oxygen, there is no tarnishing by exposure to the atmosphere, and this is one of the reasons why gold is so highly prized. It is an excellent conductor of heat and electricity, and only melts at an exceedingly high temperature. Of its compounds, the most important is chloride of gold, used for toning photographs. This last mentioned substance is obtained by dissolving gold in aqua regia and evaporating a portion of the acid.

2. Silver. (Fr. *Argent,* Ger. *Silber,* Sp. *Plata.*)

Silver is the beautiful, hard, white metal which has been held in highest esteem from the earliest times. It is sometimes found in a free state, but frequently compounded with other elements, as with chlorine to form horn silver, and with sulphur to form silver glance. It exists in small quantities in samples of galena, and the most productive of the ores obtained in the British Isles are found in the Isle of Man. In Europe, silver is found in Spain, Austria, and Germany, but the discoveries of the rich deposits of the New World, from the United States to Chili, have led to the neglect of the European mines. The specific gravity of silver is 10·5. With the exception of steel, it is not exceeded by any other metal in brilliancy of lustre. In hardness, it is intermediate between gold and copper.



A VEIN IN THE COBALT MINES OF ONTARIO

Malleable and ductile, it can be beaten into extremely thin leaves, and drawn into very fine wire possessing great tenacity. Silver is the best known conductor of heat and electricity, and in consequence it is much employed in the manufacture of delicate electrical instruments and machines.

3. Platinum. (Fr. *Platine*, Ger. *Platin*, Sp. *Platina*.)

This is one of the so-called noble metals, greyish white in appearance, and generally associated in its ore with various other metals, such as iridium, osmium, palladium, rhodium, and ruthenium. The ores are now mainly obtained from the Ural Mountains, and the metal is obtained by treating the ore successively with nitric and hydrochloric acids to dissolve out the foreign substances present. With the exception of osmium, platinum is the heaviest substance known, its specific gravity being 22·48. It is not affected by exposure to the atmosphere, and, like gold, it does not dissolve except in a solution of aqua regia. In addition, it is hard and ductile, and these various properties render it of great value in the manufacture of chemical and electrical apparatus. It is also used for tipping gold pens, and for making fine wire which is capable of supporting heavy weights. Latterly, platinum has been applied with great success to certain processes in photography, and, as the supply of the metal is somewhat limited, its price has increased at an extraordinary rate.

4. Mercury. (Fr. *Mercure*, Ger. *Mercur, Quecksilber*, Sp. *Azogue, mercurio*.)

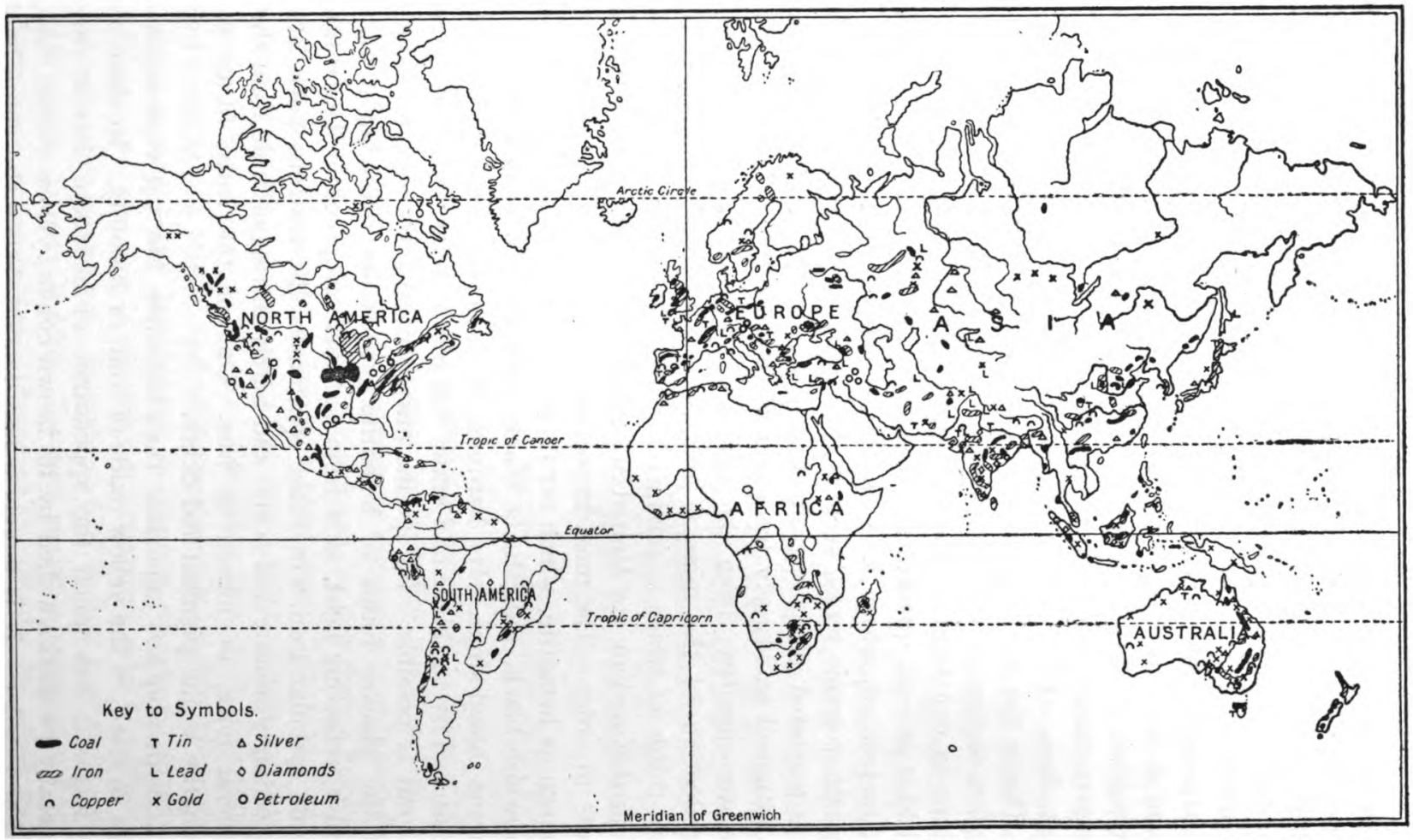
Mercury is the chemical name for quicksilver. It is the only metal liquid at ordinary temperatures. It is rarely found native, and practically the whole of the mercury of commerce is obtained from its only important ore, sulphide of mercury, or cinnabar. Formerly, the principal source of supply was Almaden in Spain, and certain districts in Italy and Austria, but now California has the leading place in the export of the ore. Cinnabar is a crystalline mineral of a bright red colour, and when roasted the sulphur burns away, the mercury being left behind as vapour, which is condensed. When pure, mercury is of a silvery brightness, which is unaltered by exposure to the air. It boils at 675° F. and freezes at -40° F. Its specific gravity is 13·6. Its uses in the laboratory and in the arts are very numerous. Owing to its affinity for other metals,

it is extensively used in separating such metals as gold and silver from their ores. One of its amalgams, with tin, is used for silvering glass mirrors, and another, with copper or cadmium, is employed in dentistry for stopping teeth. It is also valuable in the construction of barometers, thermometers, and other philosophical instruments. Mercury is largely used in medicine, especially in the form of ointments and plasters. It is also the source of the pigment vermilion. Chloride of mercury is a valuable agent for the preservation of anatomical specimens.

5. Iron. (Fr. *Fer*, Ger. *Eisen*, Sp. *Hierro*.)

This is the most important of all minerals. There is hardly a region of any extent on the face of the earth where it does not occur in one form or another, and there are some regions which yield it in vast quantities. Iron occurs native almost exclusively in meteorites, where it is usually associated with nickel, and in certain volcanic rocks, such as the basalts of Greenland, in which it is scattered about in grains and nodules. The iron of commerce is obtained exclusively from ores of the metal; and, in by far the greater quantity, from the oxides of iron. The world's annual production of the mineral amounts to nearly 60 million tons, two-thirds of which is produced in about equal quantities by the United Kingdom, the United States, and Germany. France comes next in order. The most important ore of iron is the red oxide, known as hematite, which occurs in a variety of forms. It has a brownish-black, reddish, or black colour, hence its name, which means blood-stone. Its hardness is such that it can just be scratched by the blade of a knife; but on the firmer polished forms no cut is possible. Its specific gravity is slightly over 5. Some of the blacker forms of hematite possess an exceedingly high polish, reflecting light, as if from a mirror or speculum, hence the name specular iron. In other specimens, the lustrous parts are exceedingly minute and scaly, and barely distinguishable from the mineral mica, or micaceous iron. One of the early forms of hematite is the pigment red ochre.

Considerably less important than hematite, but yet very important in itself, is the yellow oxide of iron, or limonite. In some of its forms it has much the appearance of hematite, but it can generally be distinguished by its brown colour, yellow streak, and yellow powder. It is largely a bog deposit, hence the name bog



MAP SHOWING PRODUCTS OF THE MINERAL KINGDOM

iron ore, and it is frequently even used as an ore for manufacturing purposes, in a crumbly earthy condition. Brown and yellow ochre pigments are manufactured from limonite.

A third oxide of iron is magnetite, which, as the name suggests, has the quality of being attracted by a magnet. One variety, known as lodestone, is a true magnet in itself. This important ore or iron, occurs in large, one might almost say mountain, masses. A frequent, but less serviceable form, is that of octahedral crystals of both large and small size, dispersed through other rocks. A mineral much resembling magnetite, but with much feebler magnetic qualities, and having both zinc and manganese in its composition, in addition to iron, is franklinite.

The ore known as spathic iron is obtained from the carbonate of that metal, forming the mineral siderite. It occurs in yellowish-brown rhombohedral crystals, having a specific gravity of less than 4. Yellow and green chrome pigments are obtained from chromite, or chromic iron.

One of the most familiar of all iron ores, but of no service for the extraction of the metal itself, is the sulphur ore, or iron pyrites. The beautiful and highly lustrous crystals of this mineral are likely to occur in almost any kind of rock. The crystals are cubes, or modifications of the cube, of a brass-yellow colour, and usually so hard as completely to resist the impression of a knife. This fact should readily distinguish it from gold, with which it is frequently confounded by over-zealous searchers after the precious metal. Its greater hardness and lighter colour also serve to distinguish it from copper pyrites, another form of which is known as fools' gold. Almost the only service to which pyrites are put to-day in the arts is the making of sulphur and sulphuric acid. Another sulphur ore of iron is known as pyrrhotite, or magnetic pyrites. Its reddish or bronze colour readily serves to distinguish it from ordinary pyrites, and its frequent association with nickel makes it one of the most valuable ores of that metal.

Iron is obtained from its ores by smelting with coal or coke in blast furnaces. The exact process followed depends to a large extent upon the nature of the ore. The various kinds of iron are named cast-iron, steel, and wrought iron, depending upon the amount of carbon contained in it.

When pure, iron is white. It is a most tenacious metal and very

difficult of fusion. Its specific gravity is 7·8. It is strongly magnetic, but some of its magnetism is lost when the metal is heated. Though iron does not oxidize at ordinary temperatures, it is quickly covered with a black coat when heated to redness, and rust is produced when dampness is present.

The uses to which iron is put in various manufactures are too numerous to mention. It is of the utmost importance in chemistry, and gives rise to two series of salts, known as the ferrous and the ferric. In medicine it is valuable, being used as a tonic in various combinations. It is very frequently prescribed in cases of anaemia and general debility. Iron also enters into many natural mineral waters, and these are frequently prescribed when a patient is unable to take iron in its ordinary medicinal form.

6. Nickel. (Fr. *Nickel,* Ger. *Nickel,* Sp. *Niquel.*)

Nickel is a greyish-white metal which was at one time chiefly prized as being a valuable alloy, but is now used independently for many industrial and domestic purposes. It is not found native, and its most important ore is *Kupper-nickel* (false copper), a metal with a copper-like appearance, and composed of nickel and arsenic. This ore is fairly abundant in Germany, Hungary, France, and the United States. In the smelting of the arsenical ore a product called "speiss" is first obtained, and from this the ordinary metal is extracted. The principal compound for which nickel is used is German silver, composed of 50 parts of copper, 30 of zinc, and 20 of nickel. This substance is in great demand for making the base of silver-plated goods. Some of the salts are used medicinally. Sulphate of nickel is prescribed in cases of severe headache.

7. Cobalt. (Fr. *Cobalt,* Ger. *Kobalt,* Sp. *Cobalto.*)

This is a steel-grey metal with a reddish tinge, hard, brittle, and very magnetic. It is nearly as infusible as iron. It is rarely found native, and its ores are sparingly distributed, being generally combinations with arsenic and sulphur. Our imports are mainly from Germany. The metal alone is of little value, but many cobalt compounds are employed as pigments, being remarkable for beauty and brilliance of colour, and impart a magnificent blue tint to glass. Smalt, used by paper stainers and others, is glass coloured by oxide of cobalt and reduced to a very fine powder. An impure oxide of cobalt, known commercially as "zaffre," is valuable in

enamel painting. Smalt is also used in the production of the blue colours in porcelain, pottery, glass, tiles, frescoes, etc.

8. Copper. (Fr. *Cuivre*, Ger. *Kupfer*, Sp. *Cobre.*)

Copper was the earliest metal known and worked, and was valuable in the manufacture of bronze in the remotest ages. It is rarely found in a pure state, but the extraction from its ores is not a difficult process. The principal ores are copper pyrites, copper glance, and malachite. These are very widely distributed, and the smelting works of Swansea and its neighbourhood—the greatest centre of the process of smelting—draw supplies not only from Cornwall and Devonshire, but also from Spain, Portugal, and Australia. Copper has a reddish colour, takes a fine polish, and possesses a faint odour. When exposed to moist air it becomes greenish in colour, and communicates the same colour to a flame when held in it. It is hard, malleable, ductile, and tenacious, and one of the best known conductors of heat and electricity. It dissolves in nitric acid. Its specific gravity is 8·9.

The alloys of copper are of enormous importance in manufactures. The best known are bell-metal, brass, bronze, gun metal, and speculum metal. Sulphate of copper, formed into large blue crystals, is used in calico printing and electro-plating, and in the manufacture of various pigments. Acetate of copper is commonly known as verdigris.

There are great deposits of copper in the United States, and the working of this metal has largely increased there during the last twenty years.

9. Zinc. (Fr. *Zinc*, Ger. *Zink*, Sp. *Zinc.*)

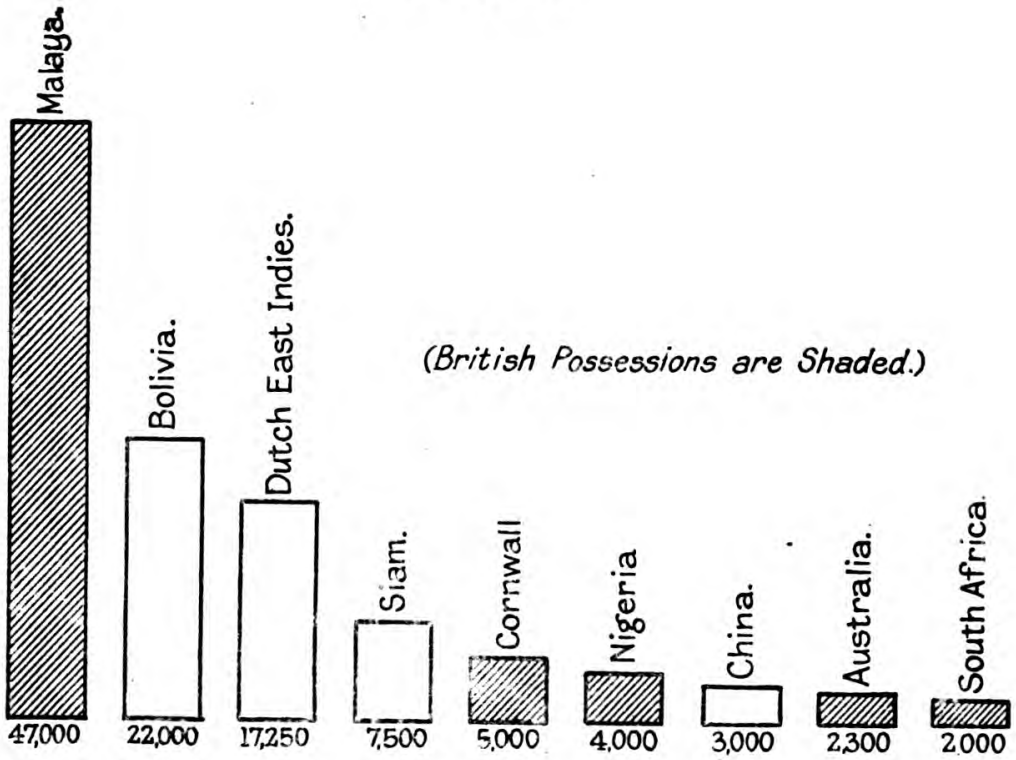
This valuable metal is bluish-white, and its specific gravity varies from 6·8 to 7·4. It is seldom found in Nature in a metallic state, but its ores, the principal of which are calamine and blende, are mined in most countries. Zinc is obtained by the ores being crushed, roasted, and smelted. In comparison with lead or tin it is a strong metal, being both hard and malleable. The commercial term for metallic zinc is spelter (the elements of which are numerous) and, by reason of its resistance to atmospheric action, it is of great importance for industrial purposes. It is used in the preparation of galvanized iron. Oxide of zinc, or zinc white, is used largely in the colour trade and in the preparation of certain

ointments. Zinc is of great value as an alloy, and enters into the composition of brass, zinc and copper being the necessary constituents.

10. Tin. (Fr. *Étain*, Ger. *Zinn*, Sp. *Estaño.*)

Is a well-known, beautiful, and lustrous white metal. It is extremely malleable, and can be rolled out into very thin plates, called tinfoil. Tin undergoes little change when exposed to the

WORLD'S TIN PRODUCTION IN 1915
(IN TONS)



air unless it is heated, when a film of oxide forms on its surface Its specific gravity is 7·3. Tin is rarely found native, but occur chiefly in the form of tinstone or cassiterite, an ore which is abundan in Cornwall and Devonshire, the Malay Peninsula, and Australia. The ore is broken into small pieces and finely pounded in a stamping machine, after which it is roasted in a reverberatory furnace and gradually purified. It is as a component of various alloys that tin is especially valuable.

The world's production of tin at the present time is estimated at about 110,000 tons a year, 60,000 tons of which are produced

from ores mined in the British Empire. In 1915 the output in Malaya was close on 47,000 tons, Cornwall produced 5,000 tons, the Nigerian output of ore represented a little over 4,000 tons of metal, that of Australia 2,300 tons, and South Africa 2,000 tons.

The chief foreign tin producing countries are Bolivia, the islands of Banha and Billiton in the Dutch East Indies, Siam, and China. In 1915, Bolivia's export of tin ore represented nearly 22,000 tons of metal, that of Banha 13,250 tons, Billiton 4,000 tons, Siam upwards of 7,500 tons, whilst China, a large part of whose output is refined in Hong Kong and returned to the country of production, contributed to external supplies about 3,000 tons.

The United States are the largest consumers of tin. Very little tin ore is mined in the States, and practically the whole of the tin used has hitherto been imported as metal, chiefly from the United Kingdom and the Straits Settlements, the total imports averaging 47,000 tons a year during the last five years. The United States manufactures large quantities of tin plates for the canning industry.

The imports of tin into the United Kingdom have averaged over a period of five years 43,000 tons of metal and 33,000 tons of ore, the latter chiefly from Bolivia and Nigeria. We exported about 42,000 tons of metal, chiefly to the United States.

About two-thirds of the world's production of tin is used in making alloys, such as bronze, pewter, and Britannia metal. But the most familiar use of the metal is for coating steel plates for making cooking utensils and receptacles for food such as meat, fish, and milk.

11. Lead. (Fr. *Plomb*, Ger. *Blei*, Sp. *Plomo*.)

One of the most useful of metals, used very extensively as sheet lead, for piping, for the manufacture of bullets, etc. It is a bluish grey metal, remarkable for its softness and fusibility. Its specific gravity is 11·36. When freshly cut it possesses a bright metallic lustre, but it quickly tarnishes on exposure to the atmosphere. It is not a good conductor of either heat or electricity.

The chief source of lead is the ore galena, a sulphide of lead found in several European countries. In Great Britain, the chief lead supply is obtained from the mines of Cumberland, but there is a considerable amount of galena imported from Spain. The galena is crushed and washed to remove earthy impurities, and then melted with proper fluxes in a reverberatory furnace. Owing to

the presence of small quantities of other metals, there are several special additional processes necessary in order to obtain the lead pure.

Lead enters into the composition of several useful alloys, of which the most important are type metal, stereo metal, plumbers' solder, pewter, and shot metal. An oxide of lead, known as red lead or minium, is much used in the manufacture of fluid glass, as a cement, and as a pigment. A mixture of lead oxide and antimony, known as yellow lead, is employed as a pigment for giving a yellow colour to earthenware. White lead, a substance extensively employed as a pigment and for pottery glaze, is a carbonate of lead. It is obtained by subjecting thin sheets of the metal to the simultaneous action of acetic acid and carbonic acid gas.

TEST PAPER VII

1. Account for the importance of the heavy metals. Name some of their leading characteristics.

2. What qualities are possessed by gold which have led to its almost universal adoption as a medium of exchange ? Mention any other purposes for which gold is used ?

3. Write short notes on the nature, sources of production, and uses of silver, platinum, and mercury.

4. State what you know about iron under the following headings—
   (*a*) Mode of occurrence.
   (*b*) Methods of working.
   (*c*) Sources of supply.
   (*d*) Chief uses.

5. Enumerate some of the chief characteristics of copper, nickel, tin, and lead.

6. Whence do English manufacturers derive their supply of iron ore ? What changes have taken place in this respect during the last half century, and to what causes have they been due ?

7. Name some of the most important iron smelting centres in Great Britain.

SECTION III

THE VEGETABLE KINGDOM

CHAPTER I

GENERAL SURVEY

THE most important basis of all economic life is to be found in the Vegetable Kingdom. In its distribution and growth, vegetation is influenced by the most varied conditions which are collectively described by the term "climate," which embraces conditions of temperature, rainfall, winds, and the alternation and duration of the seasons. Apart from these factors, however, vegetation is affected by many other circumstances.

Generally speaking, the temperature of any district depends upon its latitude and longitude. According to their distance from the equator, various regions are distinguished which have an approximately similar climate and are known as "Zones." Each of these districts or zones has its own peculiar vegetation.

The Equatorial Zone extends to latitude 15° on both sides of the equator. Here, in the moister and warmer parts, the vegetation is most luxuriant, palms and bananas being the typical plants. Other important plants are the mahogany of America, the banyan of India, valuable spices, orchids, and enormous climbing plants.

The Tropical Zones extend from lat. 15° N. and 15° S. to the Tropics of Cancer and of Capricorn. The vegetation resembles that of the equatorial, but is not so luxuriant. Figs, tree ferns, cotton, coffee, sugar-cane, bread-fruit, pineapple, cactus, and plants of the equatorial region are widely spread.

The Sub-tropical Zones extend from the tropics to lat. 34° N. and S., and possess an abundant vegetation of laurels, myrtles, magnolias, bamboo, and roses. Valuable commodities of commerce such as cotton, rice, indigo, fruit, tea, etc., are here produced.

The Warm Temperate Zones extend from lat. 34° to lat. 45° north and south of the equator. The principal plants are the

cork oak, beech, chestnut, evergreens, tree ferns, the orange, pomegranate, olive, peach, vine, and tea.

The Cold Temperate Zone extends from lat. 45° to 58° N. and S., and is marked by great climatic differences, according as the places are situated near to or at a distance from the ocean. The characteristic vegetation consists of coniferous trees, such as pines, firs, etc., and many deciduous trees, grasses, hops, and wheat. These zones consist principally of cultivated land, although in Asia there are long stretches of desert steppes.

The Sub-Arctic Zones extend from lat. 58° to 66½° N. and S., and produce very few leafy trees, but many pine trees. The principal plants are grasses, coniferous trees, birches, and willows.

The Arctic Zones, which extend to lat. 72° N. and S., consist of dwarf shrubs, rhododendrons, lichens, and bog mosses; beyond lat. 72° the only vegetation is that of reindeer moss and lichens.

Simultaneously with the distance from the equator, the mean temperature also decreases with increasing *altitude.* It is not, however, the mean annual temperature which exercises the decisive influence upon vegetation. What is more important is the distribution of heat over the various seasons, and especially the length and warmth of the summer temperature. Thus, for instance, in spite of the mild climate in the South of England, vines do not grow there, owing to the lack of a long, hot summer. Again, palms do not thrive in districts where the temperature reaches freezing point, no matter how long or intense the period of summer heat may be. An extreme continental climate, with marked alternations of frost and heat, produces a different type of vegetation from that of a temperate maritime climate.

The distribution of the *rainfall* is important, since no vegetation is possible without a minimum amount of humidity.

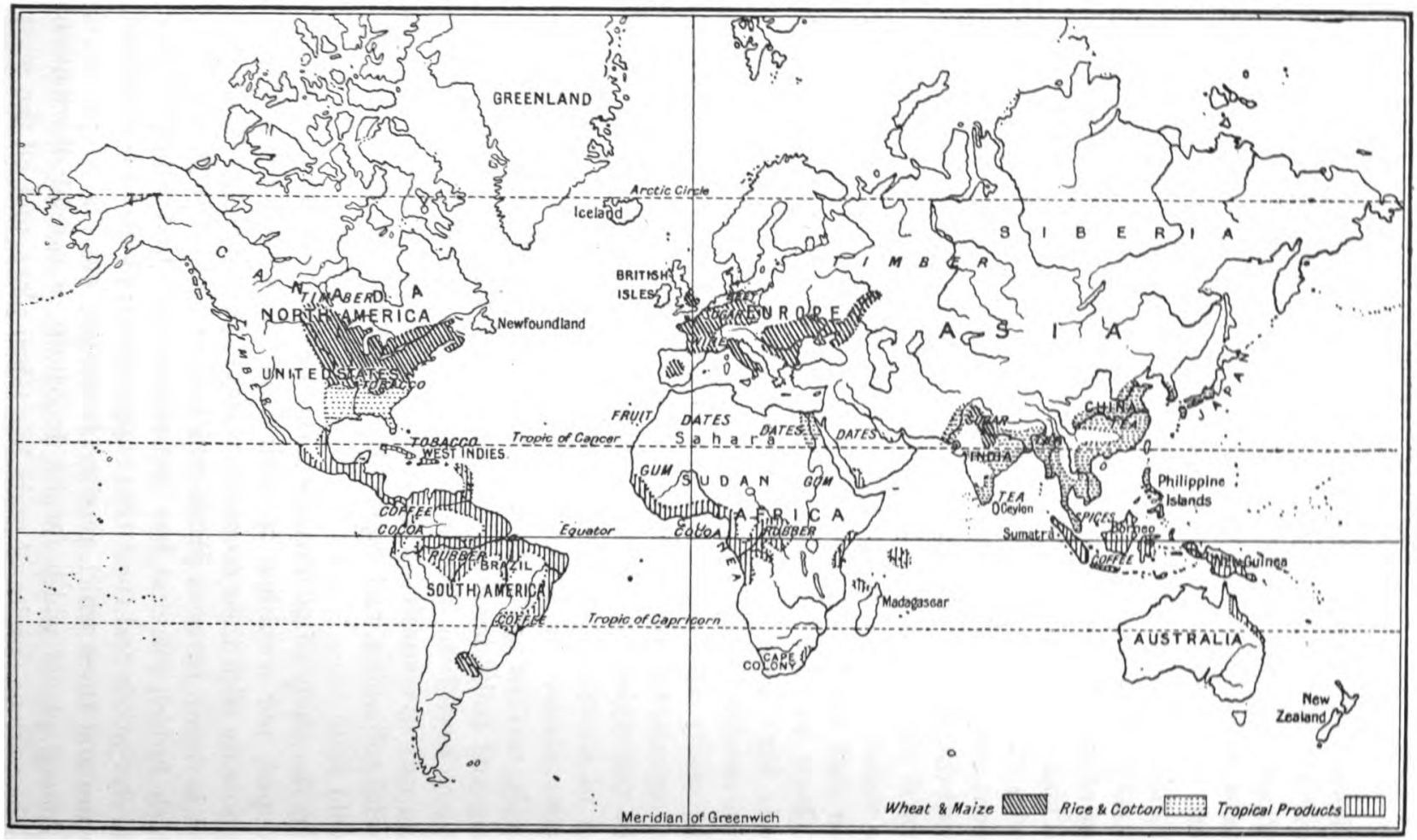
Plants which only obtain the necessary humidity at long intervals must needs be organized differently from those which draw their supply of moisture at short intervals. Some species of plants, such as cactus and steppe grasses, thrive in arid regions; some orchids require a large amount of moisture, whilst other plants positively want a marshy soil (*e.g.*, rice); others, again, require the damp, salty, atmosphere of the coasts (*e.g.*, cocos and oil pine); copious rainfall is necessary for the growth of forests.

Plants are not absolutely restricted to their native soil. They frequently migrate (on account of unknown causes), and sometimes they are deliberately transplanted to other regions, where they become acclimatized if the soil and climate are suitable. Wind, rivers, ocean currents, floating ice, animals, and human beings are the chief agencies by which plants are disseminated, and the character of the vegetation of a district may be thereby changed. Most of the principal food plants are capable of being acclimatized to a high degree, a remark which particularly applies to the various species of grain and to the vine. Naturally, plants from cold regions may be transplanted to warmer areas to a far greater extent than in the opposite case. The transplantation of genuinely tropical plants into colder regions is very difficult. Accordingly, the variety of vegetation along the lines of latitude is greater than that in a longitudinal direction. There are some species of plants which practically encircle the earth. Many European plants have been introduced during historical times, sometimes quite unintentionally.

In nearly all cases, plants useful for food, manufacturing, or for ornamental purposes have been deliberately transplanted from one region into another. Scarcely a quarter of the population of Europe could now be maintained by its originally indigenous plants. With the exception of barley and oats among cereals, and the apple and pear among fruits, all other species of grain and fruits have emanated from Asia; maize, potatoes, and tobacco have been introduced from America; and other products from various countries of the earth. These plants all thrive under careful cultivation and supervision, but cannot be left to grow in a wild state.

In the study of commodities, the various species of plants are grouped, not according to their botanical classification, but in accordance with their economic utility. In this respect a distinction is drawn between plants which serve as foodstuffs and those which furnish oils and fats and resins; trees that supply timber and dye-woods and those that supply fibres; plants of a medicinal nature and those which produce beverages, etc.

Among plants which furnish foodstuffs, a careful distribution of the various species of grain has taken place, and all the most civilized peoples are now engaged in the cultivation of these plants.



MAP OF THE VEGETABLE KINGDOM

Each natural division of the earth has also its own peculiar food plant. Thus, oats are indigenous to Europe; barley and wheat to Western Asia; rice and millet to Southern Asia; buckwheat to the Asiatic highlands; sorghum to China; dhurrah to Africa; and maize to America.

Amongst edible bulbous plants, the potato has proved to be very cosmopolitan. In hot climates there are other bulbous plants which supply easily procurable food for savage peoples (*e.g.*, yams). Various kinds of fruit have been distributed from Asia to all countries of the Temperate Zone, and fruit now forms the most important article of export from the countries of Southern Europe. Prolific sources of nourishment are provided in tropical countries by the bread fruit palm, the banana, the sago, and the cocos palms. Amongst plants which furnish beverages, the vine is very susceptible to the influences created by differences of soil, and different sorts of wine are produced from the various vine-growing districts. Other plants furnishing beverages have also been widely distributed, as, for instance, coffee, which originated from Abyssinia, but which to-day is produced within a wide belt encircling the earth—which remark applies to tea in a much lesser degree. Plants furnishing foodstuffs and forming the source of livelihood for whole districts are spices, the sugar-cane, and cereals. As regards dye-woods, most regions have their peculiar species, as, for instance, indigo in Eastern Asia and tropical America, and a whole series of dye-woods which are characteristics of South America and the West Indies. Timber is the principal article of exportation of some northern countries, such as Scandinavia, the Baltic countries, and Canada; whilst the finest timber comes from tropical America.

Fibrous Plants are very numerous, and are distributed over a wide area, whilst at the same time they supply a universal want. As an article of commerce, cotton takes the first place. It is indigenous to the tropics, and demands a dry, sandy soil and a maritime climate.

All forms of animate nature, both vegetable and animal, are combinations of carbon. It is for this reason that organic chemistry has often been described as the chemistry of carbon. Carbon constitutes, so to speak, the skeleton and the frame, as well as a high degree of the weight of organic matter and its derivatives, as in the case of liquids and gases. Thus, acetylene gas and the highly liquid benzol contain

more than 92 per cent. of carbon, whilst solid naphthaline contains as much as 92¾ per cent. Analysis has established the fact that rubber and oil of turpentine have an identical chemical composition, both consisting of 88·2 per cent. of carbon and 11·8 per cent. of hydrogen. They are isome, which is the chemical expression for such substances, and the only explanation for such bodies is that the grouping of their elements into molecules is different, this difference finding expression in the numerous formulas. Carbon and hydrogen are frequently joined by a third element in the shape of oxygen, as, for instance, in the so-called hydrates of carbon. This group of exceedingly important organic bodies consists of carbon, hydrogen, and oxygen in the proportion in which they form water, and thus they receive the name of hydrates. In this category are included—

1. Cellulose.
2. Starch.
3. Cane or beet sugar.
4. Starch or Malt Sugar.
5. Milk sugar.
6. Glucose.
7. Gum Arabic.
8. Dextrine.

The purest cellulose is cotton, and next to it comes blotting paper, which in turn is purer than wood-pulp.

Starch mixed with warm water is converted into paste at a heat of 72° C.

As a fourth element in the composition chiefly of animal matter, but also to some extent of vegetable matter (*e.g.*, coffee, opium, quinine), has to be mentioned *nitrogen*.

TEST PAPER VIII

1. Enumerate the chief zones of vegetation, and name the characteristic plants found in each.

2. Draw a sketch-map of the World showing the distribution of five of the most important vegetable products.

3. Name the principal factors which, in your opinion, determine the nature and extent of plant life.

4. What valuable commodities of commerce are to be found in the tropical and sub-tropical zones?

5. To what extent does the distribution of rainfall influence vegetation?

6. Write short notes on grain and its use as foodstuffs; bulbous plants; and fibrous plants.

CHAPTER II

VEGETABLE FOODSTUFFS

THE chief group of foodstuffs consists of those products of the field which contain starch, albumen, or protein, and embrace cereals, pulse, and bulbous vegetables.

CEREALS.

These are a species of grasses the seeds of which are very rich in flour. They were cultivated even in ancient times, but their origin—the same as that of our domestic animals—is wrapped in mystery. A distinction is drawn between the cereals of the temperate zone, such as wheat, rye, barley, and oats, and those of the tropical and sub-tropical regions, such as rice, maize, millet, etc. To a certain extent, both these groups overlap in so far as the former may be cultivated in warmer climates during the winter, and the latter in colder climates during the summer.

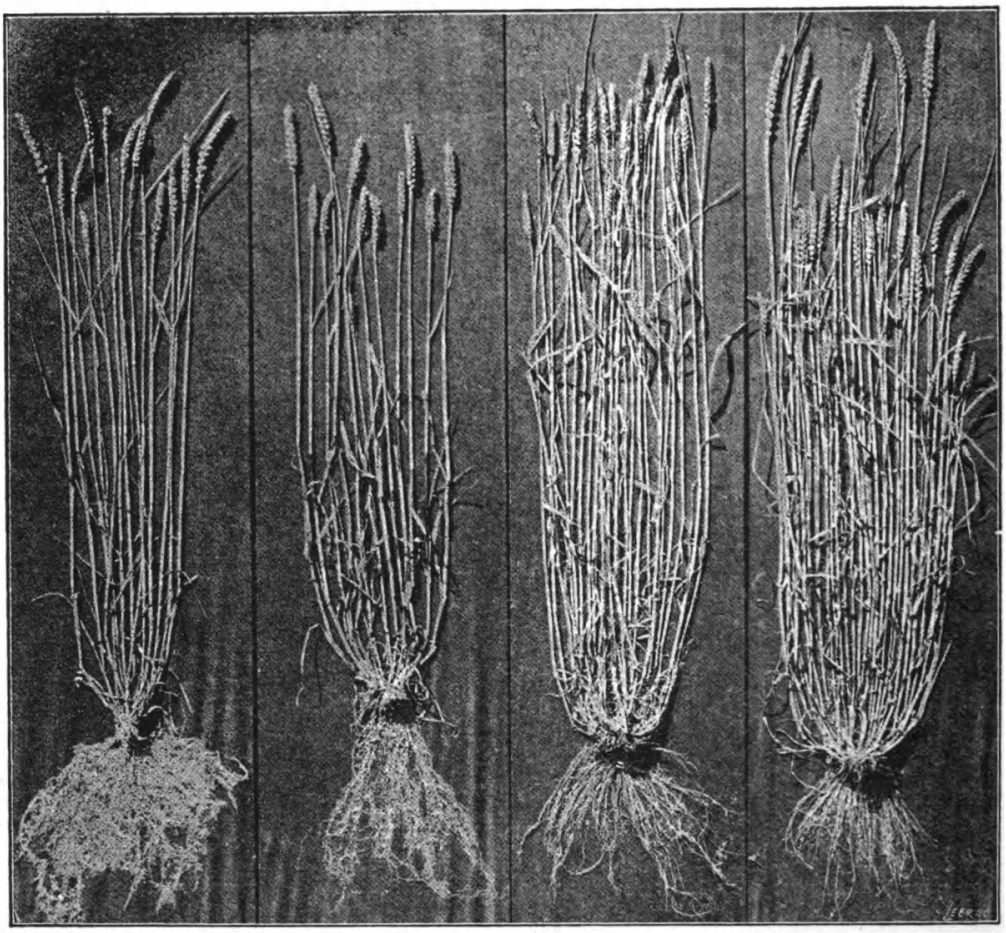
1. Wheat. (Fr. *Froment Blé*, Ger. *Weizen*, Sp. *Trigo.*)

This is the most important cereal of Europe and many other regions, and its handling in the world's trade involves the turnover of huge sums. It is more grown in the temperate parts of the world than any other grain, and it is the staple food of the more highly civilized races. The various kinds of wheat differ somewhat in their composition, but English wheat is made up as follows: water, 14·5; albuminoids, chiefly fibrin, 11; starch, 69; fat, 1·2; cellulose and lignose, 2·6; mineral matter or ash, 1·7. It is a valuable flesh-forming and nutritive substance, and is a particularly cheap article of food.

Half the world's wheat crop is produced by the principal countries of production—the United States, Russia, and France. The remainder of the crop is furnished by India, Italy, Germany, Hungary, Spain, Argentina, Canada, Roumania, and Australia.

The greatest consumer of foreign cereals is England, which draws

its supplies chiefly from the United States, Russia, Roumania, and India. The crushed grain of wheat is flour, the cuticle of the grain separated from the flour being bran. The stalk of the plant when dried is straw and contains a considerable amount of silica.



Chalk. *Sand.* *Clayey Sand.* *Clay.*

SPECIMENS OF WHEAT GROWN ON DIFFERENT SOILS

Every month in the year there is a wheat harvest in some part of the world, but the North American crop in July is the factor of greatest significance to the British Isles, not only because of its volume, but also because of the comparatively direct sea passage from these islands. The various dates of the wheat harvests of the world are—

TABLE OF WORLD'S WHEAT HARVESTS

JANUARY .	Australia, New Zealand, Argentine Republic, and Chili
FEBRUARY .	India
MARCH .	India and Upper Egypt
APRIL . .	Mexico, Cuba, Lower Egypt, Syria, and Persia
MAY . .	Morocco, Algeria and Tunis, China, Japan, Texas and Florida
JUNE . .	The Mediterranean Peninsulas, Southern France California, Afghanistan
JULY . .	France, Austria-Hungary, Southern Russia, and the United States
AUGUST .	England, Belgium, Netherlands, Germany, and Eastern Canada
SEPTEMBER .	Scotland, Sweden, Norway, and Russia
OCTOBER .	Scotland, Sweden, Norway, Russia
NOVEMBER .	Peru, South Africa
DECEMBER .	Burmah, South Australia

2. Rye. (Fr. *Seigle*, Ger. *Roggen*, Sp. *Centeno.*)

This is the predominant cereal in north-eastern Europe. More than half of the production of rye is furnished by Russia, and amounts on the average to about 22·4 million tons annually. In the Mediterranean regions rye is only cultivated in higher latitudes, where the soil and climate make the cultivation of wheat impossible, as in the Sierra Nevada and in the Atlas Mountains. In England, it is grown only as fodder for cattle, although in many parts of Europe rye bread is a commoner food for the peasantry than wheaten bread. Besides its use for making bread, rye is cultivated for distillation, the spirit called Hollands being made from it. A good beer is obtained from the malted grain. The straw is useful for thatching and straw plaiting.

3. Barley. (Fr. *Orge*, Ger. *Gerste*, Sp. *Cebada.*)

In a geographical sense, this is the most prevalent of all cereals, and in regard to the resistance of climate it is the most hardy. It is cultivated in all latitudes from the far north to the tropics (*i.e.*, in summer in the temperate and colder areas, and in winter in the Mediterranean and other climates, where it takes the place of oats as animal fodder). There are, of course, many varieties of barley grown. Large quantities are raised in the United Kingdom, especially on the lighter arable lands of Norfolk and Suffolk, and there are considerable imports into this country from Denmark,

Siberia, the United States, Canada, and Mexico. The principal demand in Great Britain is for malting purposes. Pearled barley is barley which has been husked and treated by machinery for use in thickening broth and soups.

4. Oats. (Fr. *Avoines*, Ger. *Hafer*, Sp. *Avenas*.)

This is distinguished from barley by a stronger stalk and an ear which faces all directions. It is sown late in spring and the crop is harvested in midsummer. Oats thrive on a poorer soil than barley, and this fact, in conjunction with the smaller corresponding yield in barley, has been responsible for the increase in the production of oats at the expense of barley. There are more than forty species of oats, and these are widely distributed over the temperate and cold regions of the globe. The area of cultivation is wider than that of wheat, and in the United Kingdom oats are cultivated to double the extent of wheat. Scotch grown oats are superior to English grown. The deficiency of the British supplies is made up by imports from northern Europe generally, and especially from Russia. The grain itself is principally used as a horse food, and, owing to its greater yield of albumen and fats, it is greatly superior to barley as a human foodstuff. It is usually ground into meal for the purpose of making porridge and cakes.

5. Buckwheat. (Fr. *Sarrasin, Blé noir*, Ger. *Buchweizen Heidekorn*, Sp. *Alfarfon*.)

Although this is not a cereal, yet it may be included in this category owing to the richness in flour of its seeds. Tartary may be considered the home of buckwheat, and from Central Asia the cultivation of it has spread to the greater part of Asia, northern Europe, and North America, although it has not become an important factor in the feeding of mankind. With 63·6 per cent. of starch, 15·2 per cent. albumen, and 3·4 per cent. of fatty matter, buckwheat has an even higher nutritive value than wheat. It is grown to but a slight extent in England, where it is of little use except for the feeding of pheasants. Beer is made from it, and it is not unknown in gin distilleries. The husks are sometimes used as a packing material. In Russia and the United States, however, buckwheat and buckwheat cakes enjoy a great popularity, and in the latter country buckwheat cake and syrup form the last course of the substantial American breakfast.

TEST PAPER IX

1. Distinguish the cereals of the temperate zone from those of the tropical and sub-tropical regions.

2. What are the most favourable conditions for the cultivation of wheat? Show how these are related to the distribution of the chief wheat-growing districts.

3. How do you account for the wheat harvests of the world occurring at different seasons?

4. Compare rye, barley, and oats as foodstuffs.

5. Write short notes on the following—

Buckwheat, barley, and oats.

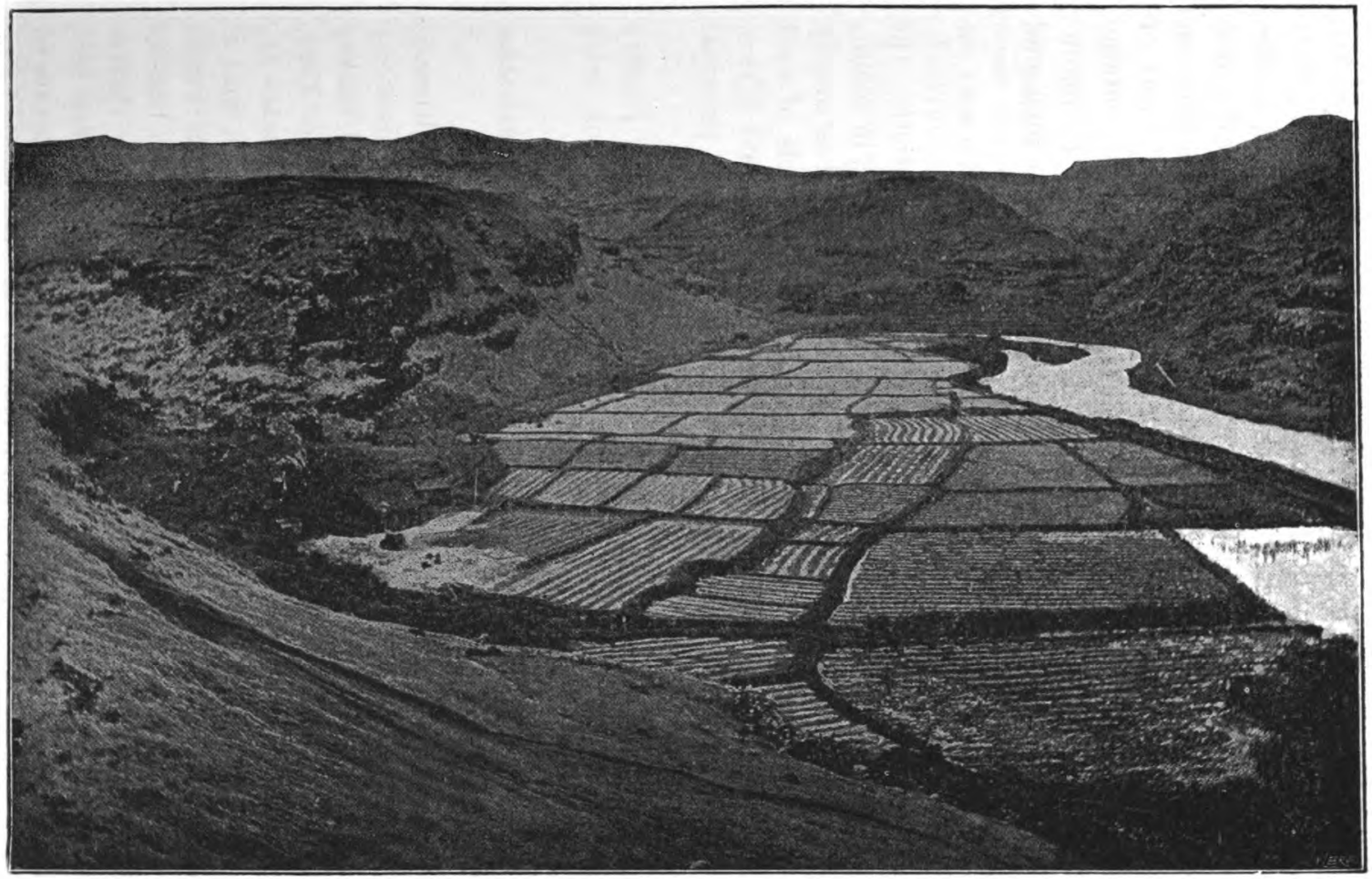
CHAPTER III

CEREALS OF WARM COUNTRIES

1. Rice. (Fr. *Riz*, Ger. *Reis*, Sp. *Arroz.*)

Rice is the most important cereal in the monsoon area of Asia, where it forms the daily food of two-thirds of the population. In 100 parts, rice contains 12·8 parts of water, 7·3 of albumen, 78·3 of starch, 0·6 of fat, 0·4 of fibre, and 0·6 of ash. This shows that amongst all cereals it is the one richest in starch, whilst in its nutritive value, as far as this is determined by albumen, it is considerably below wheat, rye, and oats. It is an easily digestible food, and, owing to that fact, it is often given to children and elderly people. It is grown extensively in all tropical and sub-tropical countries, and to some extent in Spain, Italy, and Austria.

The cultivation of rice throughout the tropical and sub-tropical regions spread but slowly. In early times it was imported into Madagascar by Malayan immigrants, whose descendants still use it as their staple article of food. Indian and European slave traders took it to the east coast of Africa, where it spread to the interior of the Continent soon after the discovery of America. In the river valleys of Upper Guinea rice has thus been cultivated for centuries. However, those samples of African rice which have been shown in European exhibitions have not been very inviting. In the Mediterranean region, rice was introduced after the Mohammedan conquests during the seventh and eighth centuries. The cultivation of rice has assumed a large extent in Lombardy, where it is carried on with great care under a system of crop rotation. The Alpine rivers furnish most of the water necessary for irrigation. The chief centres of this agricultural industry in Italy are Vercelli and Pavia. In the United States, rice has been cultivated in South Carolina since 1684, and in Louisiana since 1718. In recent times these two States have been joined by Texas, where a peculiar system of irrigation has been introduced. It consists of the water of the tidal rivers being directed at times of flood into the rice fields by means of a system of locks. The area under cultivation in the



TYPICAL RICE FIELDS

United States has been considerably increased by this addition of Texas. After the rice crop is cut, the grain is husked and quickly dried, special machinery being used for the former process. It is then ready for the market. Besides its use as a foodstuff, a wine is made from it in China and Japan, and a spirit can also be distilled from rice and molasses. Rice is sometimes used by distillers in Great Britain. It is also in great demand for the manufacture of starch, owing to its cheapness and to the fact that it contains more starch than wheat. Rice straw is employed in the manufacture of bonnets. The refuse of rice, consisting of the husk and broken grain, forms a valuable cattle food.

2. Millet. (Fr. *Millet,* Ger. *Hirse,* Sp. *Mijo.*)

This embraces a considerable number of different varieties, the grain being in all cases more or less round and shiny, and, in colour, white, yellow, red, brown, or even black. The kernel is mostly yellow or white. Millet is rather important as an article of food for the population of the mountainous regions of Asia and Africa, and its nutritive value is greater than that of rice. The principal home of millet is India.

In England, the seeds are only employed as a food for poultry and cage birds, the small supplies required for consumption being imported mainly from Italy.

3. Maize. (Fr. *Maïs, blé de Turquie,* Ger. *Mais, Türkischer Weizen,* Sp. *Maiz.*)

This is the only cereal of the New World which was cultivated by the civilized peoples of Mexico and Peru long before the discovery of America. Its cultivation was introduced into Italy and Turkey from Spain. Maize is distinguished from the aforementioned kinds of cereals of the Old World chiefly by the fact that the sexes are separated. It is very commonly known as Indian corn, and is one of the most important grain crops of the world, next in importance to rice. It is grown chiefly in the United States, but its cultivation is now very widespread. In Britain, it only thrives in favourable summers, since its cultivation requires a deep soil, plenty of sunlight, and a good deal of rain. The grains are arranged in compressed parallel rows along a central axis, the whole being called a cob. There are many varieties of maize, depending upon the climate, soil, and mode of cultivation.

The rich yield of maize, and the fact that it may be converted into a palatable food by roasting, have made it very popular in some countries.

From the grass, sugar, treacle, and vinegar can be obtained. From the flour of the grain, corn-flour is prepared. The straw is used for making writing and printing paper.

TEST PAPER X

1. Account for the importance of rice as a foodstuff.
2. Give an account of the geographical conditions most suitable for the growth of rice.
3. Locate the chief rice-growing districts of the world.
4. Write short notes on the following—
   Maize, millet, and rice.
5. What are the conditions most suitable for maize production?

CHAPTER IV

PULSE

THIS is the collective name for the seeds of leguminous plants. Peas and beans are the most common and important, and after them come kidney beans, lentils, chick peas, etc. In some countries the cultivation of pulse is almost as important as that of cereals. Its cultivation is of such long-standing that the origin of most varieties is unknown. Characteristic of the various kinds of pulse is their manner of forming the fruit (*i.e.*, in a pod). Like cereals, pulse in a ripe state is dry, and the two rows of seeds are separated by a thin inedible skin. The nutritive value of pulse is very high, since it contains 45 to 50 per cent. of starch, 23 to 25 per cent. of albumen, and small portions of sulphur and of phosphorus. It is considered less digestible in its ripe state than cereals.

Every species of pulse in its raw state has a disagreeable taste, which, however, disappears in the process of cooking or roasting. The albumen does not curdle in cooking, except when an acid is added. The most important species of pulse are—

1. Peas. (Fr. *pois*, Ger. *Erbsen*, Sp. *Guisante.*)

Peas are greater favourites in warm and dry districts than in wet and cold ones, where they are more difficult to harvest. They are frequently sown along with beans. Since the general introduction of turnips, they have not occupied so important a place in crop rotations as hitherto.

2. Chick Pea. (Fr. *pois chiche*, Ger. *Kichererbse*, Sp. *garbanzo.*)

This is the name given in India to various kinds of pulse. It is somewhat extensively cultivated in the south of Europe and in India for the sake of its seeds, which are eaten by the natives of the latter country. Between 10,000 and 15,000 tons are annually exported from India for horse and cattle food. Oxalic acid can be extracted from the leaves and stems of the plants.

3. Lentils. (Fr. *Lentilles*, Ger. *Linsen*, Sp. *Lentejas.*)

This is a leguminous plant closely related to the vetch. It is extensively cultivated in Egypt, Syria, and Southern Europe

generally. From the seeds a palatable and nutritious food is obtained. In the east they are cooked as a sort of porridge. In Great Britain, the lentil seeds are used for the preparation of invalids' food, especially the food known as Revalenta Arabica, and in the lists of imports they are included with tares. The principal exporting country is Egypt. The cultivation of the plant in England has been frequently suggested, but the attempts have not been successful, owing to the absence of sufficient warmth.

4. Beans. (Fr. *Haricot,* Ger. *Bohne,* Sp. *Habas.*)

This is a pulse of the largest sort commonly cultivated in the fields. Beans grow admirably in Egypt, where there are large fields entirely devoted to their cultivation, the blossoms of which are much more odoriferous than those of Europe. There are twenty-five species of beans, seven of which are natives of the British Isles.

5. Ground Nuts. (Fr. *Noix de terre,* Ger. *Erdnüsse, Erdeicheln* Sp. *Castanas. de tierra.*)

This plant is a native of Africa, though it is cultivated in the West Indies and in India. It is remarkable from the fact that the pods of nuts are first formed in the air, and are afterwards forced into the ground as they increase in size, and there ripen.

Ground nuts are valuable as a food in the regions where they abound, and enter largely into commerce on account of the oil which they contain. They are imported into France in large numbers, mostly from the West Coast of Africa to Marseilles. The fixed sweet oil obtained resembles olive oil and is often used as a substitute for it. On the Continent, the oil is sometimes used for culinary purposes; in this country only as a lubricant.

6. Carob Tree. (Fr. *Caroube,* Ger. *Johannisbrodbaum,* Sp. *Algarrobo.*)

This tree is a species of pulse and is found near the shores of the Mediterranean. It is somewhat like the apple tree in size and appearance. The pods are known as carob-beans, and contain a sweet and nutritious pulp. They are one of the commonest ingredients of cattle foods. In Spain and Italy a strong spirit is made from them, as well as a liqueur. Other names of carob-beans are locust pods or locust beans and St. John's bread.

7. Soya Bean. (Fr. *Fève Soya*, Ger. *Soyabohne.*)

The Soya bean is extensively grown in China and Japan, chiefly for the pleasant flavoured seed from which is prepared a piquant sauce. It is also widely grown in India, where the bean is eaten, while the plant forms a valuable fodder; it is cultivated for the latter purposes in the United States.

TEST PAPER XI

1. Explain the meaning of the term " pulse."
2. Enumerate the most important species of pulse which enter into commerce.
3. Say what you know of Soya beans. Where are they grown, and for what purposes are they used ?

CHAPTER V

BULBOUS PLANTS OF A STARCHY NATURE

THIS family of plants is characterized by a high proportion of water, always more than 50 per cent., but sometimes up to 75 per cent., with a small per cent. of albumen (which, in cooking, curdles like the albumen in blood or in eggs), and a smaller percentage of starch, rarely exceeding 25 per cent. The most important representatives of this group are—

1. Potato. (Fr. *Pomme de terre,* Ger. *Kartoffel,* Sp. *Patata.*)

This is one of the most familiar and important of vegetables. Its original home was the western part of South America, where it is said to be still growing in a wild state in Chili. The potato has been greatly changed by cultivation, and numerous varieties are now produced which greatly differ from each other in shape, size, and colour. The history of the potato begins in 1565, in which year John Hawkins took some on board an English slave trader when provisioning his ship in New Granada (now Colombia) and introduced them into Ireland. Twenty years later, potatoes were brought to England by Sir Francis Drake, and finally, again in 1623, by Sir Walter Raleigh. This marks the spread of the potato in Europe, and to-day it plays as important a *rôle* in the food of some peoples as bread itself.

In addition to its use for domestic purposes, the potato is largely employed as a food for cattle. Its starch can be separated from the potato with ease, by grating and washing, and this substance is prepared on a very large scale. It is chiefly used in textile factories under the name of farina, which is converted into dextrine. In Holland and in Russia, large quantities of the starch are converted into sugar, and in various European countries it is passed off as a substitute for arrowroot. A spirit is also obtained from the potato and made into potato brandy. The British imports fluctuate enormously, the quantity depending upon the home supply.

2. Yams. (Fr. *Igname.* Ger. *Yamswurzel.*)

These are large elongated white bulbs which, in favourable soil,

contain a weight of 20 to 30 lb. They are grown creeping up poles, as in the case of pepper or beans. They are usually grown in Monsoon countries, and also in Polynesia.

3. Tapioca. (Fr. *Tapioca,* Ger. *Tapioka,* Sp. *Tapioca.*)

This is the granulated starch of a species of *Manihot,* extensively cultivated in South America, and also in the East Indies. The starch is obtained from the root of the plant, and carefully roasted on hot plates, great care being taken not to overheat it. In its commercial form it appears as small lumps, crisp, transparent, and very irregular in shape. The varieties known are: fine flake, medium pearl, and seed pearl. Tapioca is highly nutritious and forms an excellent food for infants and invalids. The chief exports are from Brazil and Singapore.

4. Arrowroot. (Fr. *Arrow-root, herbe à la fléche,* Ger. *Marantastärke, Pfeilwurzel,* Sp. *Almidon.*)

This is a species of starch which is obtained by grinding and washing the tubers of various plants. The West India Islands are the principal source of the supply of arrowroot, and the most prized is obtained from the Bermudas. When prepared, it is a light, opaque, white powder, and crackles when rubbed. Although it is absolutely without odour when it is dry, it possesses a peculiar smell on being dissolved in boiling water. Immense quantities are imported into Great Britain, mainly from the Bermudas. Arrowroot has long been much valued as a delicacy, and as an easily digested food for children and invalids.

TEST PAPER XII

1. Write a short account of the history of the introduction of the potato into Europe.
2. Say what you know of yams, tapioca and arrowroot.

CHAPTER VI

PLANTS SUPPLYING NON-ALCOHOLIC BEVERAGES

1. Tea. (Fr. *Thé*, Ger. *Tee*, Sp. *Té*.)

Amongst the most important commercial plants of the Asiatic monsoon countries must be included the tea plant, the cultivation of which dates back to the seventh century of the Christian Era, when it was known in China. It was introduced into Europe in 1610 by the Dutch, and soon found an acceptance in the various countries as a palatable and stimulating beverage.

The tea plant is an evergreen shrub with thick leaves and white flowers. The leaves are picked by hand and subjected to various processes, such as drying by exposure to air, roasting, rolling by hand, and again roasting over charcoal fires. The best tea is obtained from the young leaves of the plant. The different kinds of tea depend upon the varieties and qualities of the plant, the soil, the climate, and the method of treatment. Green tea is obtained in the same manner as black tea, but in the case of the former the leaves of the plant are exposed to the air for a shorter time than when the latter is produced. Of black teas, the best known are Congou, Pekoe, Souchong, and Bohea; while Hysons and Gunpowder are the principal green varieties.

Until the middle of the nineteenth century, almost the whole of the tea which entered into commerce was obtained from China, but since that time the cultivation of the tea plant has been increasing in India and Ceylon, and now more than one half of the supplies of the world are derived from the Indian Empire.

Green tea is chiefly consumed in Japan, North America, and the Mohammedan countries, whilst the tea preferred by other peoples is black tea, which, after being piled up in a damp condition, is permitted to undergo a process of fermentation.

Tea leaves are converted into the so-called brick tea by being mixed up with some binding substance and pressed into the shape of bricks. This brick tea is chiefly exported to Russian Asia, where it is also consumed in the form of a soup. The principal countries furnishing tea are India, Ceylon, China, Japan, and Java.

JAPANESE WOMEN PLUCKING TEA

The most important consumers of tea are Great Britain and her Australian Colonies, where the annual consumption amounts to about 7 lb. per head of the population. The United States of America and Canada likewise consume large quantities of tea, being the principal consumers of the green Japanese tea. On the European Continent, the Russians are the greatest consumers of Chinese tea, although in recent years they have begun to import Indian and Ceylon tea by way of Odessa or through England. Strange to say, the consumption of tea in Germany is very small.

Tea forms one of the commonest articles of consumption, and its stimulating action is the result of the presence of the alkaloid theine or caffeine.

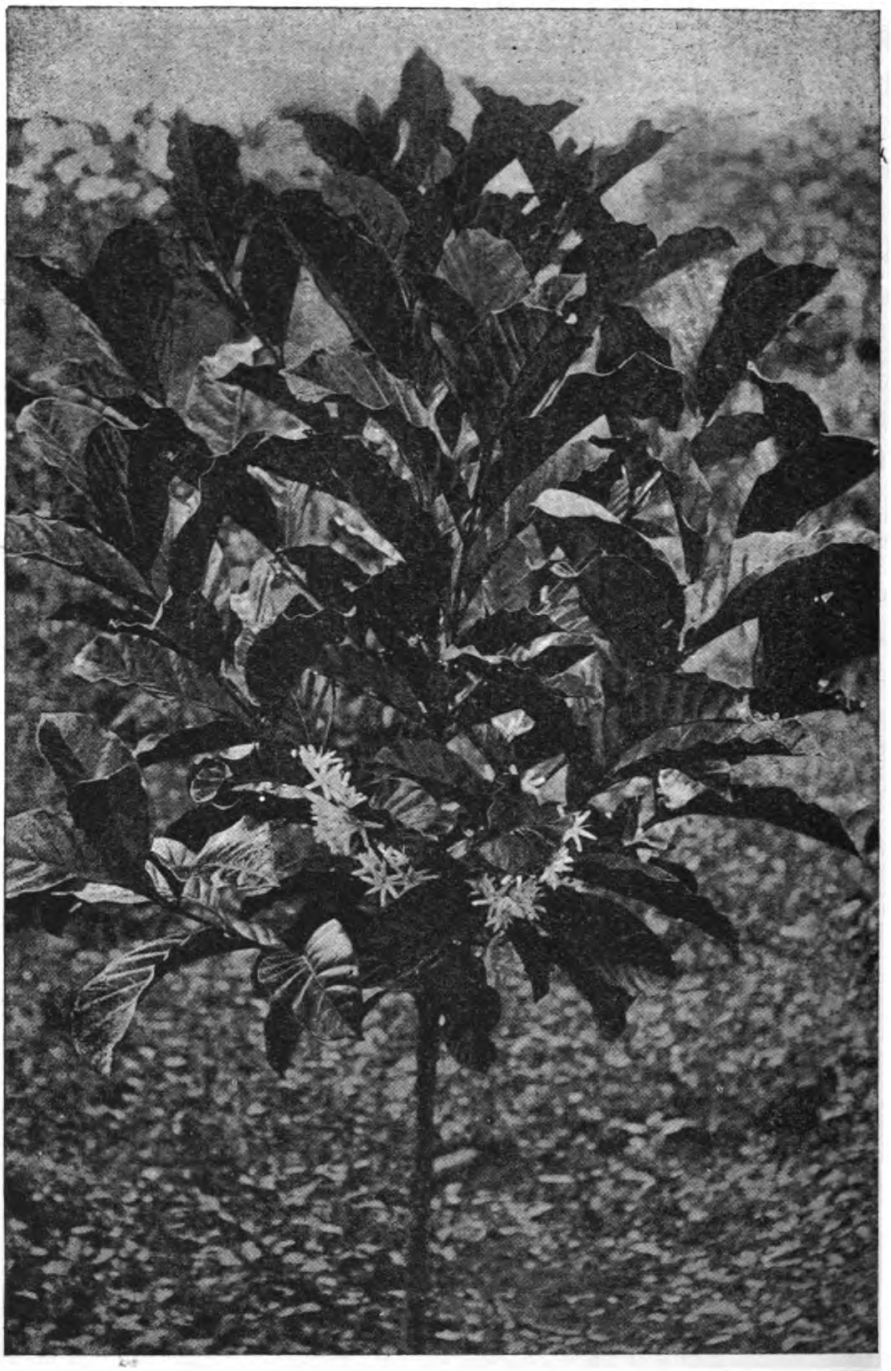
2. Coffee. (Fr. *Café*, Ger. *Kaffee*, Sp. *Café*.)

This plant, like that of tea, is an evergreen, but of much more recent cultivation. It is grown over a large portion of the tropical regions and is of even greater importance than tea as regards quantity and value. In this plant, it is not the leaves but the seeds which produce the beverage. It came originally from Abyssinia, where it is grown as far south as the 10th degree of latitude, whence it was imported into Yemen, in Arabia, in the fifteenth century. From the latter place it was transplanted by the Dutch in 1690 to Batavia. In 1720, the first coffee plant was introduced into Martinique; in 1762, Brazil took up its cultivation, and in 1827, Ceylon. In regard to quality, the coffee beans of Yemen occupy the premier place. They are small, uneven, and hard, with plenty of aroma. Next in quality comes Java, with large yellow or blue beans, and then follows Ceylon.

The berries of the tree are gathered when ripe and variously treated in order to remove all foreign matter. They are afterwards roasted, with the result that there is a great reduction in size, and a development of a volatile oil and a peculiar acid. When used for domestic purposes, chicory is very frequently added to coffee.

The active principle of coffee is caffeine, and the physiological effect of taking it is to stimulate the brain and produce sleeplessness. It is thus an antidote to narcotic poisons.

Essence of coffee is a concentrated infusion of coffee mixed with extract of chicory and burnt sugar, the mixture being made as thick as molasses.



A LIBERIAN COFFEE PLANT IN FLOWER

India, Ceylon, Java, Brazil, and Arabia are the chief exporting countries.

3. Cocoa. (Fr. *Cacao,* Ger. *Kakao,* Sp. *Cacao.*)

This is the name given to a beverage prepared from the seeds of the Cacao tree, which is grown in tropical districts. The tree is a native of the West Indies and tropical America, though it is cultivated also in Asia and Africa. The fruit is shaped like a cucumber, and within are the seeds, the cocoa nibs of commerce, from which the cocoa is obtained. To prepare cocoa for use, the seeds are roasted and bruised to loosen their skins, and the seed lobes are crushed and ground between rollers to reduce them to a pasty consistence. The sweetened paste, flavoured with vanilla or cinnamon, constitutes chocolate.

Cocoa contains the active principle *theobromine,* an alkaloid resembling caffeine. Owing to the presence of fatty and nitrogenous matter it forms an excellent food. The number of preparations made from cocoa, when the oily matter called butter of cocoa has been extracted, is considerable, the principal being cocoatina, cocoa essence, and concentrated cocoa.

The chief supplies of Great Britain are derived from Trinidad and the States of Central America.

4. Sugar. (Fr. *Sucre,* Ger. *Zucker,* Sp. *Azucar.*)

This is the well-known article of food which occurs in the juices of many plants, but which is prepared for commerce almost exclusively from the sugar-cane and the beetroot. The sugar-cane is a gigantic grass found in the tropical regions of both hemispheres. It has a cylindrical stem, the sap of which is rich in sugar in its ripe condition. After the stems have been cut they are passed between heavy rollers for the extraction of the juice, which is run into tanks and heated with lime. The substance is then allowed to stand for a time, and is afterwards skimmed. The heating and skimming processes are repeated several times until the mixture is free from scum. A thick syrup remains and this is passed into shallow pans, in which, as it cools, sugar crystals are formed. The crystalline mass is the raw sugar, and the dark substance which drains off is molasses. Various modified mechanical contrivances are in use in different sugar producing countries. Beetroot sugar is prepared somewhat similarly from the beet. The root is crushed

or sliced and the solution boiled down. The subsequent processes are the same for both cane and beet sugar. The manufacture of sugar from the beetroot has long been an important industry of France, Germany, Austria, and Russia. In order to prepare sugar for use and for commerce it is necessary to refine it. For this purpose the raw sugar is dissolved and filtered to remove impurities, and further treated with animal charcoal to remove the colouring

REAPING SUGAR CANES IN THE WEST INDIES

matter. The pure, colourless syrup is then run into vacuum pans, where it is evaporated until crystals are formed. This is the sugar of commerce, though further treatment is necessary to present it in the different forms under which it is sold.

During the last twenty years there have been very great fluctuations in the sugar trade. The beet sugar has competed keenly with the cane sugar, and the bounties granted by various foreign countries have inflicted great hardships upon the refining industry in Great Britain.

TEST PAPER XIII

1. Enumerate the chief plants which supply non-alcoholic beverages.
2. Write a full note on the trade in tea with special reference to—
   (*a*) The chief centres of production.
   (*b*) The principal countries of consumption.
   (*c*) The changes in (*a*) and (*b*) during the last half-century.
3. Write short notes on—
   (*a*) Green tea; and
   (*b*) Black tea.
4. Where is coffee chiefly grown ? Sketch briefly the process of manufacture of the finished product.
5. Give an account of cocoa under the following heads—
   (*a*) Areas of production.
   (*b*) Areas of consumption.
   (*c*) Method of preparation for the market.
6. In what regions are beet sugar and cane sugar respectively produced, and what are the advantages in the cultivation of each kind ?

CHAPTER VII

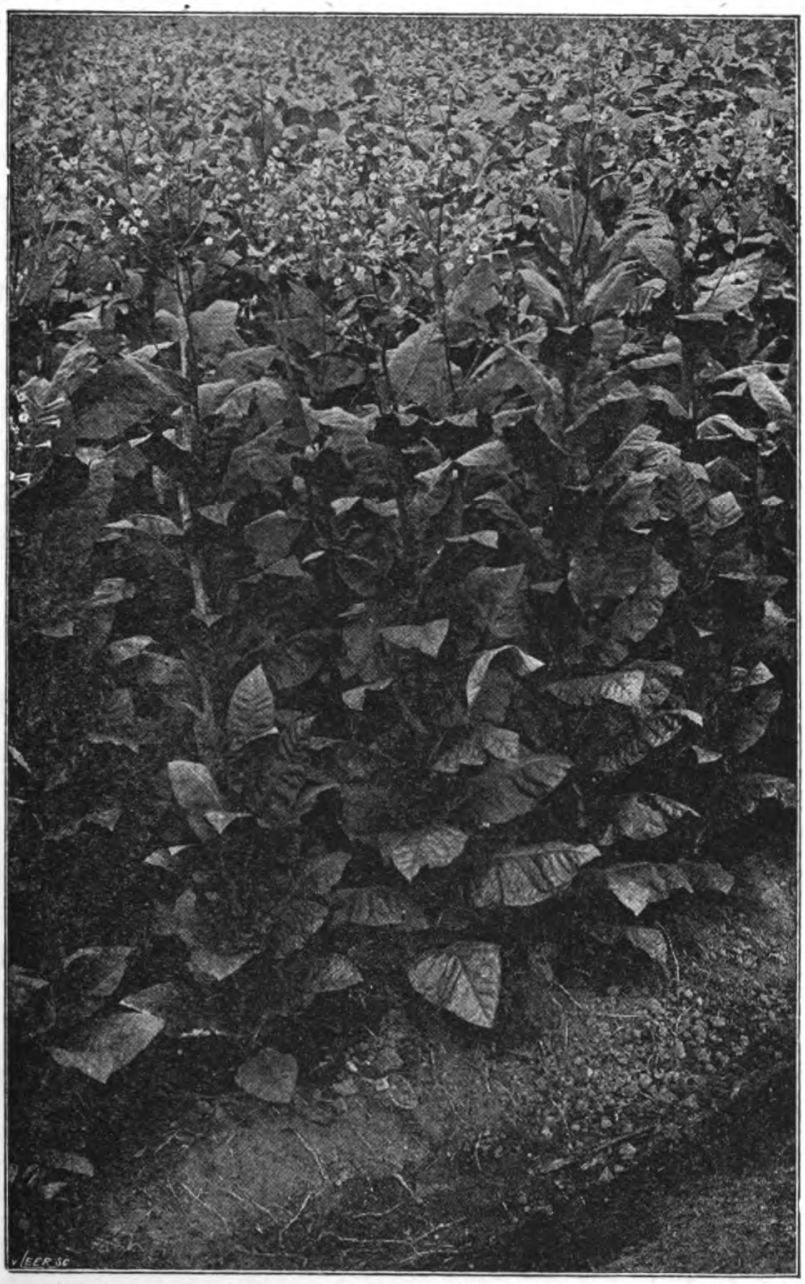
NARCOTICS

1. Tobacco. (Fr. *Tabac,* Ger. *Tabak,* Sp. *Tabaco.*)

This consists of the dried leaves of several species of ***nicotiana,*** the principal being the ***nicotiana Persica,*** the source of the highly prized Persian tobacco, the ***nicotiana rustica,*** from which the tobacco of Latakia, Turkey, and Manilla are derived, and the ***nicotiana repanda,*** the American variety of the plant. The tobacco plant is remarkable for its straight stems and long broad leaves. It is grown on both sides of the equator, as far as the 50th parallel of latitude, but its properties, especially those of the volatile oil and alkaloid nicotine, vary according to the climate, the soil, and the conditions of cultivation. To prepare it for the market, the leaves of the tobacco plant are cut, dried, and stripped. The process of drying varies in different parts of the world; sometimes it is done naturally by the sun, while at other times artificial means are used. The leaves are generally allowed to lie in heaps for a week or two and covered over, during which period a slight fermentation takes place. After being sorted the leaves are pressed and packed in barrels for exportation. The subsequent treatment and manufacture give rise to the various commercial varieties which are well known in the market. Shag is the moistened and compressed leaves which are afterwards cut into fine shreds. Cavendish is the name given to tobacco leaves which are moistened with syrup and pressed into cakes. For the manufacture of twist tobacco, the fermented leaves are twisted either by hand or machinery into the form of rope—the thin rope being called pigtail, and the thicker rope bogie.

For the manufacture of cigars, the midribs of the dried leaves are first removed. The leaves are then moistened with water or a solution of nitre and rolled round smaller fragments into cylindrical form. For good cigars, the leaves should be uniform throughout, but, owing to various causes, common leaves are very frequently used for the interior. The best Havana cigars are all derived from Cuba, but Havana boxes are frequently filled with cigars of inferior brands. Cheroots come from the Philippine Islands. Mexican

and Brazilian cigars have recently come into favour, as well as a cheaper kind manufactured in India.



TOBACCO GROWN FOR SEED PURPOSES IN SUMATRA

Cigarettes were at one time made almost exclusively from tobacco grown in Syria. They are now manufactured from many different kinds, the tobacco being frequently scented or adulterated with opium.

Snuff is made from moistened tobacco, which, after fermentation, has been dried, powdered, and scented.

The supplies of tobacco for Great Britain are chiefly derived from different parts of America, the Levant, India, Sumatra, and the Philippine Islands. Except under very limited conditions, the cultivation of the tobacco plant in Great Britain is forbidden under heavy penalties.

2. Opium. (Fr. *Opium*, Ger. *Opium, Mohnsaft*, Sp. *Opio.*)

Another narcotic drawn from the vegetable kingdom is opium, which is one of the most valuable medicinal drugs. It consists of the dried juice of the unripe heads of a species of white poppy, grown in Turkey, Persia, India, and China. The cultivation of the poppy for the sake of the opium is mainly carried on in Bengal and Oude. It is exported from India to China in enormous quantities. Great Britain derives its supply of opium to a large extent from Persia and Turkey. In the former country it is prepared at Ispahan, Shiraz, and Yezd, that coming from the last-named town being considered the best. To procure opium, the unripe capsules or poppy heads are scratched with a peculiar kind of knife, and the exuding juice is collected in earthenware vessels on the day after the incision has been made. The thick liquid is subjected to various kinds of treatment, and the opium is made up into cakes or bulbs and left on racks to dry. Much care is required both in the manufacture and in the drying, and the quality of the drug depends upon the peculiar treatment it receives. The best varieties of opium are soft dark brown or reddish brown masses, possessing a peculiarly disagreeable odour and a persistent acrid taste. Its medicinal value is owing to the fact of the presence of so many different alkaloids, the most important of which are morphine, narcotine, codeine, narcine, thebaine, and papaverine. Opium is a valuable sedative and anodyne, and a stimulant when taken in small quantities. Its abuse may lead to grave results. Laudanum is a tincture of opium. It is composed of opium dissolved in dilute alcohol.

TEST PAPER XIV

1. In what particular areas and under what conditions are tobacco and opium respectively cultivated ?
2. Give an account of the chief narcotics which enter into commerce.
3. State what you know of the opium trade.

CHAPTER VIII

FRUIT

THIS is the name given to any fruit which in the ripe state is edible either wholly or in part without previous preparation. There are four different classes of fruit—

1. Berries (*e.g.*, strawberries, raspberries, and gooseberries).
2. Hard fruit (*e.g.*, apples and pears).
3. Soft fruit (*e.g.*, plums, figs, peaches, apricots, etc.).
4. Shell fruit (*e.g.*, nuts, bananas, etc.).

I.—BERRIES

The chief berries used as fruit are—

1. Strawberries. (Fr. *Fraises,* Ger. *Erdbeeren,* Sp. *Fresas.*)

These are the sweet succulent fruit of various cultivated species of shrub widely distributed through the temperate regions of the globe. Forced strawberries are obtainable throughout the year, but the season for the natural grown fruit in England is from the beginning of June to the end of July. They are not only used for dessert, but in the manufacture of jams. For the latter purpose there are extensive imports, but the quality of the fruit is not nearly so good as that which is home grown.

2. Raspberry. (Fr. *Framboise,* Ger. *Himbeere,* Sp. *Frambuesa.*)

The red fruit of a plant widely distributed through Europe and Asia. The acid sweet fruit is used not only as a dessert fruit, but is made into jam, jelly, syrup, and raspberry vinegar. The last named is prepared by mixing crushed raspberries with an equal proportion of malt or wine vinegar, and allowing the whole to stand for a few days. The juice is then strained out, refined, cane sugar is added, and the product is boiled. Brandy is often added. After skimming and cooling, the raspberry vinegar is bottled.

3. Gooseberry. (Fr. *Groseille a maquereau,* Ger. *Stachelbeere,* Sp. *Uva espina, grosella.*)

The fruit of a prickly shrub with small, greenish flowers. The fruit is well known, and is sold in enormous quantities in the

northern parts of Europe and America. In the south of Europe it is very little known. There are many varieties, and the cultivation is rapidly extending. The best gooseberries in England are produced in Lancashire. Besides its wholesomeness and pleasantness as a fruit, and its employment in making preserves, the gooseberry is used for the manufacture of certain wines, especially a spurious champagne, and vinegar.

II.—HARD FRUITS

These include such fruit as apples and pears.

1. Apple. (Fr. *Pomme*, Ger. *Apfel*, Sp. *Manzana*.)

This is the fruit of a tree grown in temperate latitudes, and is imported chiefly from Canada, United States, New Zealand, and Australia, where the secrets of successful packing have been carefully studied. Large quantities of cider are made from apples in Devonshire, Normandy, and Brittany.

2. Pear. (Fr. *Poire*, Ger. *Birne*, Sp. *Pera*.)

This is the well-known fruit of a tree widely distributed through Europe and Asia. It is extensively cultivated in England, especially in some of the western counties, where there are extensive orchards devoted to the purpose. Besides its common use as a dessert fruit, the pear is the source of perry.

III.—SOFT FRUITS

1. Plum. (Fr. *Prune*, Ger. *Pflaume*, Sp. *Ciruela*.)

The well-known fruit of various species of *Prunus*, valuable as a dessert fruit, as a preserve, and also in its dried state. In addition to the plums grown at home, England imports very large quantities from France, where many fine varieties of the plum tree have been cultivated, notably the Orleans, the damson, and the greengage. Elvas are imported from Portugal, and Carlsbad plums from Germany are frequently met with in the English market. The wood of the plum tree is fine-grained and rather hard. It is useful for making musical instruments, and it is likewise employed by cabinet makers.

2. Prunes. (Fr. *Pruneaux*, Ger. *Pflaumen*, Sp. *Ciruelas pasas*.)

The dried fruit of the Julian variety of the common plum. The fruit is dried either artificially or by simple exposure to the sun.

Nearly the whole of the prunes of commerce are obtained from various districts of France, the major portion being grown chiefly in the Bordeaux district. After the Julian variety, the Brignoles, the Catherines, and the prunes d'Eute and Robe Sergent are the best known. From the orchards of the Loire the Tours prunes are obtained, and from Lorraine the variety called Quelche. Small supplies are drawn from Germany, Bosnia, and Serbia. In addition to their use as dessert and for domestic purposes, prunes are of value medicinally and enter into the compound known as confection of senna.

3. Apricot. (Fr. *Abricot*, Ger. *Aprikose*, Sp. *Albaricoque.*)

The well-known fruit of different varieties of the *prunus Armeniaca.* There are various forms and varieties of this fruit, the most famous being the Royal, Turkey, Moorpark, and Breda. It is a native of Armenia, though now cultivated in many parts of the world. From its kernel prussic acid may be obtained, and by distillation the French *eau de noyaux* is also derived from it.

4. Peach. (Fr. *Pêche*, Ger. *Pfirsiche*, Sp. *Albérchigo, abridor.*)

The velvety edible fruit of a species of trees belonging to the same genus as the almond, of the natural order *Rosaceae.* The growth of peaches is widespread throughout the temperate regions of the world, and the fruit is much prized as a peculiar delicacy. There are no less than 200 varieties of the fruit. One of the divisions of peaches is into clingstones and freestones, according as the pulp clings to or is easily detached from the stone. The cultivation is most extensive in the United States, whence peaches are exported both tinned and fresh. The flowers and the leaves of the peach tree have the smell of bitter almonds, and a preparation known as peach water is prepared by distilling the bruised leaves. The smooth variety of the peach is called nectarine. The wood of the peach tree is sometimes used by turners and cabinet makers, and is valued for its compactness and smoothness.

5. Fig. (Fr. *Figue*, Ger. *Feige*, Sp. *Higo.*)

The fruit of the *Ficus carica*, a plant belonging to the nettle order, but sometimes included in the mulberry order. It is a native of the east, but it is now successfully cultivated in many sub-tropical countries, and especially in the south of Europe. The fruit is eaten either fresh or dried, but it is in the latter state that

it forms an important article of food in the countries where it grows, and an extensive subject of commerce. The drying takes place either in the sun or in specially constructed ovens. Enormous quantities are annually imported by Great Britain from Mediterranean countries. The best come from Smyrna, of which there are three qualities, Eleme, Erbeli, and Aidin. They are packed in small oblong boxes, round drums, or baskets. Portugal, Greece, and Italy are next in order as to exports. A spirit is sometimes distilled from fermented figs, and ground figs are frequently mixed with coffee. A customs duty is imposed on all figs imported into Great Britain.

6. The Vine. (Fr. *Vigne*, Ger. *Weinstock*, Sp. *Viña.*)

The vine is a genus of about thirty species of plants which are widely spread in the North temperate zone. The best known and longest cultivated species is the old-world grape-vine, *Vitis vinifera;* which occurs wild in the Mediterranean region. The old-world species is also extensively cultivated in California. Some of the American varieties have been introduced into France and other countries infested with *Phylloxera*, to serve as stocks on which to graft the better kinds of European vines, because their roots, do not suffer so much from the attack of the insects as the European species.

The character of the wine resulting from the fruit depends mainly on the nature of the soil, the climate, and the variety of wine cultivated. The quality, as distinct from general character, depends almost entirely on the weather conditions preceding and during the gathering of the grapes, and the subsequent fermentation. Wines produced in countries possessing temperate climates are usually finer than those made in hot or semi-tropical countries. The wines of Italy, Greece, and the Cape, for instance, cannot compare as regards elegance and flavour with those of France and Germany.

The total wine production of the world amounts to roughly 3,000 million gallons, of which France and Italy are the chief contributors. These two countries are followed by Spain, Portugal, Austria-Hungary, and Germany.

The greatest consumption of wine takes place in the areas of production, and the discrepancy between the consumption of

different countries is very great. Thus, for instance, the consumption per head in France is estimated at about a hundred times that of the United Kingdom, and twenty times that of Germany. The whole of the wine consumed in the United Kingdom is imported.

IV.—SHELL FRUITS

1. Nuts. (Fr. *Noisettes*, Ger. *Nüsse*, Sp. *Nueces.*)

These are fruits whose seed is enclosed in a hard covering or shell, which does not open when the fruit becomes ripe. The chief nuts of commerce are the hazel-nut, chestnut, Brazil nut, and cocoanut. Ground nuts are the seeds of a plant, the fruit of which ripens underground. These seeds are largely exported from West Africa. Large quantities of nuts are also exported from Spain (Barcelona), Italy, and Brazil.

2. Banana. (Fr. *Banane*, Ger. *Banane*, Sp. *Banana.*)

The fruit of the tropical banana tree, a species of tree allied to the plantain, though the fruit itself is sweeter than that of the plantain. Bananas are now grown most extensively in the West Indies, and there is an enormous export trade from the various islands, Jamaica supplying the wants of the United States, as well as a large part of the demands of Europe. The fruit is gathered in bunches, and must be shipped green, as it is very perishable when ripe. There are two kinds—red and yellow skinned. The largest yellow kind are obtained from the mainland of Central America, the small yellow from Jamaica, and the red from Cuba.

TEST PAPER XV

1. Give a classification of the chief kinds of fruit, and bring out clearly the chief members of each class.

2. What are the principal factors determining the cultivation of the vine? Name the chief wine-manufacturing districts of Europe.

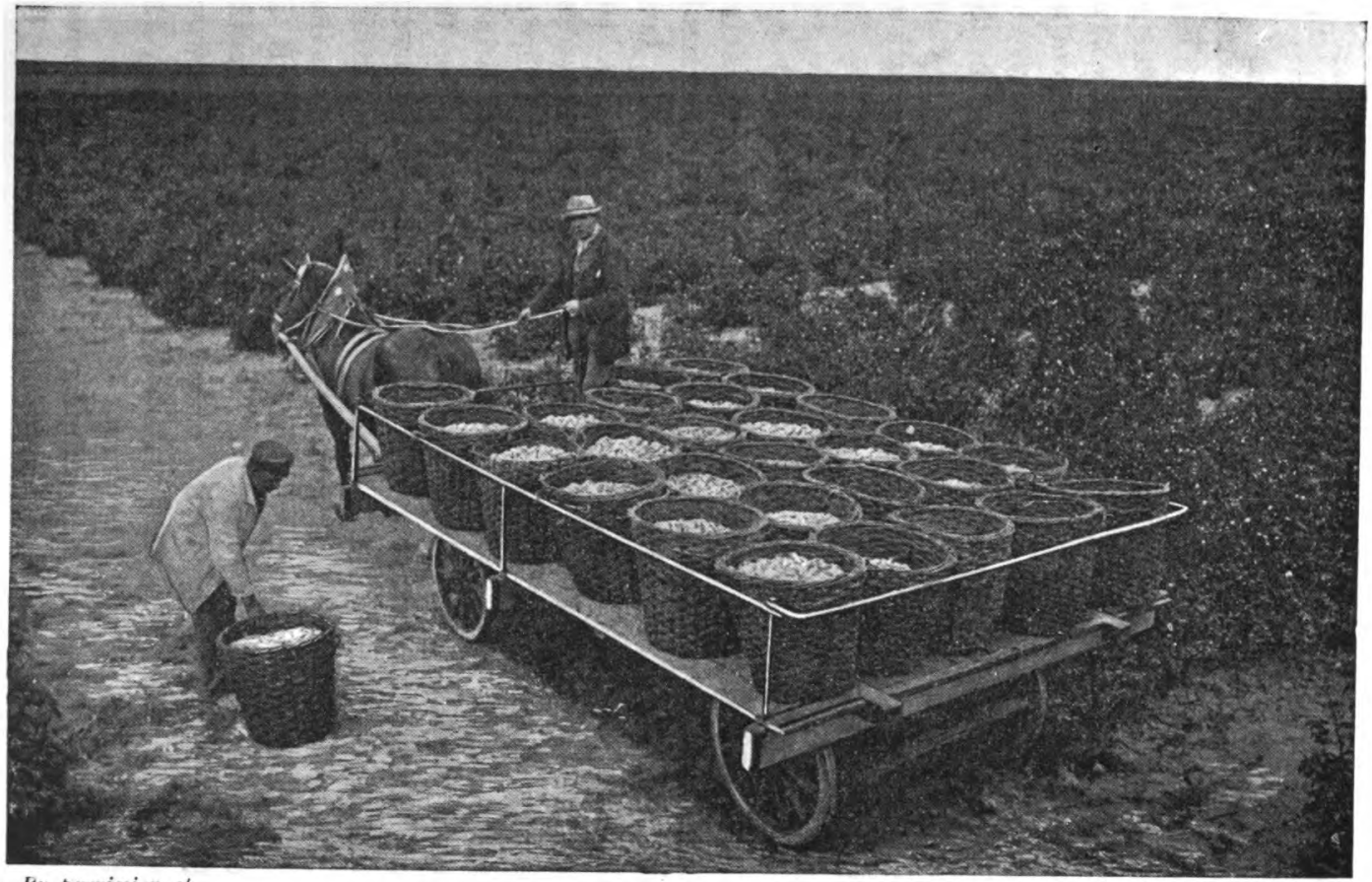
CHAPTER IX

ESSENTIAL OILS AND RESINS

THERE is an intimate connection between these two groups in so far as resins are the products resulting from the oxydation of essential oils. The volatility or liquidity of the latter determines their odour, and they differ from oils and fats, which, in the pure state, are odourless, and when heated disintegrate, thus creating a disagreeable smell. Most of the numerous scents or odours exhaled by living plants, and especially the scents of flowers and fruits, are due to the existence of essential oils.

Essences are the solutions of these odours in water, alcohol, or in any other liquid. Should a drop be placed on paper, a stain is left behind, as in the case of fat; such stains, however, evaporate and disappear entirely. Essential oils, by absorbing oxygen, become resins, whilst an intermediary product containing a mixture of both appears in the shape of balsam; in the case of coniferous trees, it is the turpentine solution of resin in oil of turpentine. Most essential oils are obtained by distillation with water of plants, as, for instance, attar of roses, the production of which from roses has rendered famous the Roumelian town of Kacanluch. Amongst the most precious of perfumes must be included vanilla—an orchid plant from Mexico which has been transplanted to the Island of Reunion and other tropical districts. The vanilla plant is a parasite orchid which, like the mistletoe, grows on trees extracting their nourishment from the atmosphere. The perfume is derived from the fruit of the tree, which consists of long cylindrical pods of the thickness of a quill. These pods contain the precious essence called Vanilla Camphor, which is easily soluble in ether and alcohol.

Resins are a class of vegetable products of great value in the arts. Some are obtained as exudations from various trees, some are found in a fossil condition, while others are extracted from various plants through the agency of alcohol. They are largely employed in the manufacture of varnishes, while medicinally they play an important part in the mixing of ointments.



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A ROSE HARVEST

The most important essential oil is turpentine, which is obtained from the various conifers found in different countries.

1. Turpentine. (Fr. *Térébenthine*, Ger. *Terpentin*, Sp. *Trementina*).

This is the oily, semi-solid, resinous substance which exudes from various species of pine trees, though Venice turpentine is obtained from the larch. The chief seat of the turpentine industry is North Carolina, from which state Great Britain imports over 20,000 tons per annum in barrels. By distillation, oil of turpentine is obtained and resin is left behind. This oil of turpentine is the ordinary turpentine of commerce, and is extensively used in the preparation of oils, paints, and varnishes. Medicinally it is valuable as a local irritant to be applied in the case of rheumatism, and as an antiseptic.

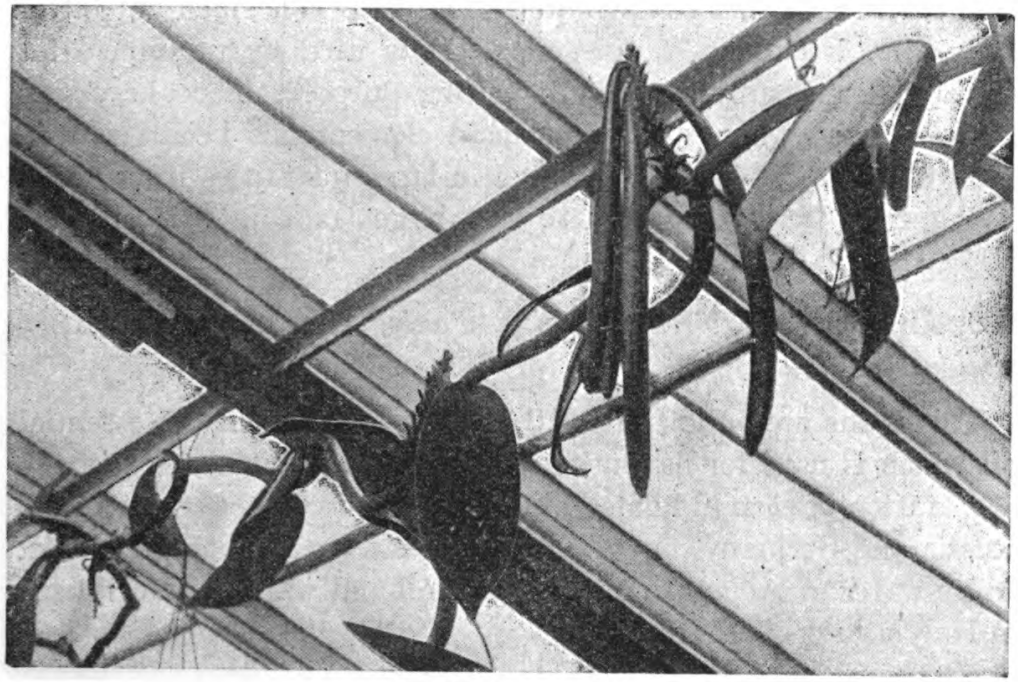
2. Camphor. (Fr. *Camphre*, Ger. *Kampher*, Sp. *Alcanfor*.)

This is a solid essential oil found in many plants, but extracted for commercial purposes from a kind of laurel which abounds in China and Japan, and which has been introduced into Java and also into the West Indies. To obtain the camphor, the wood of the tree is cut into small pieces and boiled in water, the camphor rises with the steam and condenses at the top of the vessel. In its rough state it is exported to Europe, where it is again purified and refined by heating and condensing the vapour. When pure, camphor is a white, soft, semi-transparent body, with a peculiarly strong aromatic odour, and a bitter burning taste. It is slightly lighter than water, and only dissolves in that liquid to a very small extent, forming camphor water. It is, however, readily soluble in alcohol, ether, acetic acid, and essential oils. Inflammable, it burns with a white smoky flame. The wood of the camphor tree, as it is sometimes called, is valued by the cabinet maker.

The medicinal properties of camphor have long been known, and it is used for external application as well as internally for various complaints. Owing to its strong odour, it is employed in the preservation of natural history specimens for driving off insects. The fumes of camphor have long been recognized as of great antiseptic value.

3. Menthol. (Fr. *Menthol,* Ger. *Menthol,* Sp. *Menthol.*)

This is a kind of camphor obtained from oil of peppermint by cooling. It is, however, generally prepared from a species of tree which is more productive of menthol than peppermint. It is made into the form of cones or pencils, and is a household remedy in various nervous complaints, such as headache, neuralgia, toothache, etc. Its effectiveness is caused by the rapid evaporation of the menthol after rubbing the part affected. It is sometimes prescribed in cases of diphtheria.



A VANILLA VINE

4. Vanilla. (Fr. *Vanille,* Ger. *Vanille,* Sp. *Vainilla.*)

This is a species of orchid, and the only variety which has any economical value. The most esteemed fruit is a native of the West Indies, but it is now extensively cultivated in most tropical countries. The fruit is a kind of cylindrical food from 7 to 10 in. in length. It is gathered before it is ripe, and generally steeped in the oil of the cachu nut. Vanilla has a strong and agreeable smell and a sweet taste. It is much used by perfumers, and it is also employed for flavouring chocolates, sweetmeats, ices, and liqueurs. The chief imports are from Mexico, Brazil, and Mauritius.

5. Essential or **Volatile Oil of Almonds.** (Fr. *Huile volatile d'amandes amères, Essence d'amandes amères,* Ger. *Bitteres Mandelöl,* Sp. *Aceite amargo de almendras.*)

The amygdalin contained in bitter almonds acting upon another constituent, emulsin, or synaptase, causes the formation of the essential or volatile oil of almonds. The oil is obtained from bitter almonds, when the cake from which the fixed oil has been extracted is steeped in water and submitted to distillation. The essential oil then forms and comes over, and consists of a mixture of several substances, especially hydrocyanic acid and benzoic acid. In commerce, it is a golden-yellow liquid of an agreeable smell but bitter taste, and is extremely poisonous. It is used by perfumers for scenting soaps, and also for flavouring purposes in cookery and confectionery, when the prussic acid element has been removed from it. The oil can be extracted in large quantities from peach and apricot kernels, and there is a large trade in this business carried on at Damascus.

6. Aniseed. (Fr. *Anis, grains d'anis,* Ger. *Anis,* Sp. *Anis, simiente de anis.*)

This is the aromatic fruit of the anise. It contains an essential oil which is used for flavouring cordials and medicine, and in the preparation of certain kinds of liqueurs. Aniseed is obtained from Russia and Germany, but the best comes from Alicante, in Spain. Anise water, a preparation from anise oil and water, is much used in Italy as a cooling drink.

7. Balsams. (Fr. *Baumes,* Ger. *Balsame,* Sp. *Balsamos.*)

Different species of liquid resins or saps, of a more or less agreeable odour, which are derived from various plants. They are most commonly procured by incisions being made in the stems or branches. When first obtained they are liquid or semi-liquid, glutinous, and aromatic. By exposure to the air they become thick and then solid. Frequently they contain an acid of the aromatic series. The kinds of balsam are very numerous. Canada balsam is useful for mounting microscopical objects, Copriba balsam is used for lac varnishes and tracing paper, whilst others are employed in the manufacture of perfumes and as expectorants. The name at one time comprehended all medicines compounded of resins and oils. When now

used, without any addition, balsams of Peru and Tolu are understood.

TEST PAPER XVI

1. Write brief notes on—
   Essential oils, resins and essences.
2. Enumerate the chief kinds of essential oils which enter into commerce.
3. Comment on the following—
   Turpentine, camphor, menthol, vanilla and aniseed.

CHAPTER X

TEXTILE MATERIALS

THE importance of the textile trades in the national economy, and the area which they cover in the industrial life of the nation, are strikingly shown by the summarized statistics in the Final Report on the First Census of Production of the United Kingdom. Though relating to the year 1907, these official Census figures may be taken as probably fairly representative of the position to-day, and they are especially valuable because they bring into one focus the numerous branches of these varied and ramified industries. The textile group, as defined in the Census, embraces all trades " engaged in the preparing, spinning, weaving, bleaching, dyeing, printing, and finishing of cotton, wool, flax, jute, silk, cocoanut fibre, horse-hair, and other textile materials; in the manufacture of lace, hosiery, elastic webbing, ropes, twines, and nets, and in the preparation of flocks and rags."

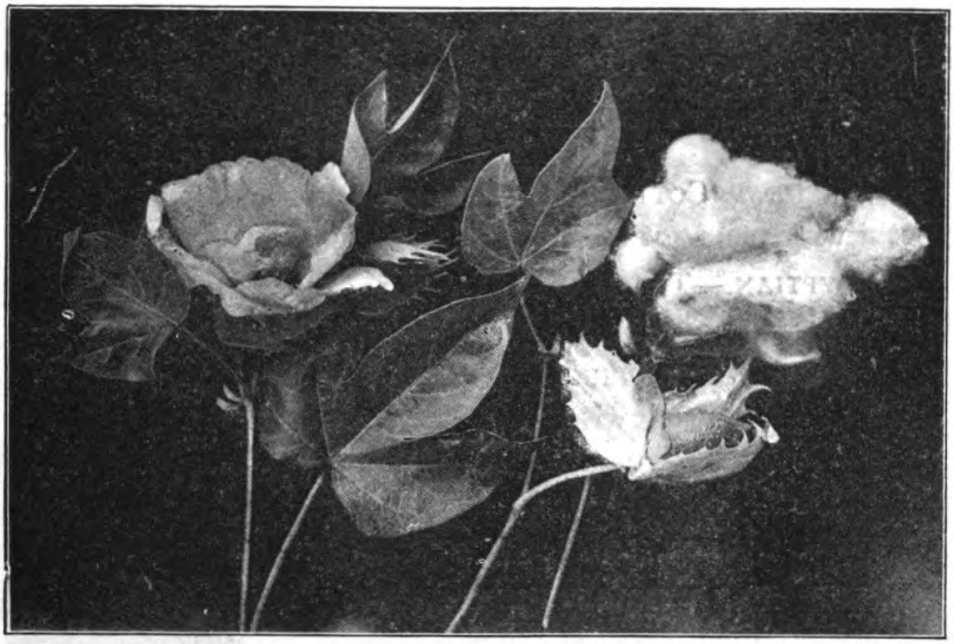
The commanding position held by the cotton industry is seen at once from the following figures of net output and employment in the respective textile industries—

TABLE OF TEXTILE TRADES, SHOWING NET OUTPUT AND PERSONS EMPLOYED.

	Net Output. £	*Persons Employed (except Outworkers).*
Cotton Trade	45,007,000	572,100
Woollen and Worsted Trades	18,597,000	264,000
Jute, Hemp, and Linen Trades	9,452,000	154,500
Silk Trades	1,762,000	32,200
Lace Trades	3,595,000	36,800
Hosiery Trades	3,139,000	51,200
Elastic Webbing Trades	283,000	4,170
Coconut Fibre, Horse-hair, etc., Trades	427,000	6,280
Rope, Twine, and Net Trades	1,072,000	14,260
Flock and Rag Trades	331,000	6,390
Bleaching, Dyeing, and Finishing Trades	10,483,000	103,800
Flax—Scutching Trades	74,000	3,860
Velvet and Fustian Cutting Trade	112,000	3,440
TOTAL TEXTILE TRADES	£94,334,000	1,253,000

1. Cotton. (Fr. *Coton*, Ger. *Baumwolle*, Sp. *Algodon.*)

One of the most important of vegetable fibres, cultivated extensively in various parts of the world up to the 36th parallel of latitude. It is obtained from the seeds of various species of *Gossypium*, a genus of plants belonging to the mallow family, but there are really not more than three which yield the cotton of commerce. The plants vary in size according to climatic conditions, and the flowers are rich and showy. The fruit is a three or five celled capsule, bursting open when ripe, and containing numerous seeds,



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COTTON BOLLS

which are covered with the beautiful filaments known as cotton, generally white in colour. The seeds are picked and the fibre is separated from them by a process called "ginning." The cotton is afterwards compressed by a screw or by a hydraulic press into bales, and when these have been secured by iron hoops it is ready for the market. The bales differ in size, weighing from 300 to 600 lbs. each, according to the country from which they come. The seeds are pressed for the purpose of extracting a bland oil from them, and the residuary cake is useful for feeding cattle.

As cotton is valued according to the special characteristics it possesses and its peculiar adaptability to the uses for which it is

required, various classifications have been made. American cotton is divided into the following series: (1) fine, (2) good, (3) good fair, (4) fully fair, (5) middling fair, (6) good middling, (7) middling, (8) low middling, (9) good ordinary, (10) ordinary, and (11) inferior. Samples of each of these classes are kept at the offices of the Liverpool Cotton Brokers' Association, for comparison in case of disputes arising, and also for reference. Another division is based upon the places from which cotton is obtained—

1. AMERICAN COTTON.—Sea Island or Long Georgia supplies the silky, regular, long staple cotton, the finest and costliest grown. Upland Georgia and Mobile is soft and rather short in the staple. Texas is finer in the staple than Mobile, but less bright in appearance. Of all the American cottons, New Orleans is the best and most regular.

2. BRAZILIAN COTTON.—Generally, this is harsh in staple and gives a wiry feel to yarns into whose composition it enters.

3. EGYPTIAN.—The brown is soft and silky, and the white is generally hard and harsh.

4. TURKEY AND GREECE.—These are harsh in staple and the fibres are irregularly twisted.

5. PERUVIAN.—There are both hard and soft varieties. The soft is much like the cotton of New Orleans, and the hard is usefully mixed with Brazilian.

6. EAST INDIAN.—Of a poor character, and containing a large quantity of round and flat fibres.

The principal supply of cotton is derived from the United States, though there are very large imports from India. Among the other countries which send cotton to the United Kingdom, Egypt is well ahead as regards quantity.

England has held a pre-eminent position in the manufacture of cotton goods ever since the trade was transferred from India to Europe.

The figures of raw material consumed show that during the twenty years before the war the consumption of cotton in this country had grown by nearly 20 per cent., and that nearly the whole of this growth took place in the second half of the period.

The whole of this vast supply was obtained from abroad, and as to 94 per cent. of it, from two countries—the United States

and Egypt. The following table, based on our own Board of Trade returns, is eloquent of the concentration of our demand for cotton on these two main supply sources—

IMPORTS OF RAW COTTON INTO GREAT BRITAIN.

(In Millions of Lbs.)

	U.S.A.	*Egypt.*	*Peru.*	*Brazil.*	*India.*
1907 .	1,588	325	22	45	45
1908 .	1,422	269	22	—	34
1909 .	1,523	314	22	11	34
1910 .	1,344	246	22	22	67
1911 .	1,534	269	22	22	45

Attempts to enlarge the area of supply have been made for a number of years, and the enterprise has received the heartiest support and encouragement from all persons actively interested in the cotton trade, and from the Government.

Cotton Manufacture.—The modern cotton industry dates from the latter half of the eighteenth century. In 1733, Kay invented the fly shuttle. Arkwright's patent for spinning with rollers was granted in 1769. Hargreaves' spinning jenny was protected in the following year. Crompton completed his mule in 1779. These and other inventions revolutionized the industry. They were the means of making cotton fabrics the cheapest and the best clothing for the world's population, and proof of this assertion, already overwhelming, is strengthened year by year.

The world's cotton spindles number about 142,000,000, and are distributed as shown in the following table—

TABLE SHOWING THE DISTRIBUTION OF THE WORLD'S COTTON SPINDLES.

(In Millions)

Great Britain	55·6
United States	30·5
Germany	11·0
Russia	8·9
France	7·4
India	6·4
Austria	4·8
Italy	4·5
Mexico	3·1
Spain	2·2
Japan	2·2
Switzerland	1·3

Belgium	1·4
Canada	·8
Sweden	·5
Portugal	·4
Holland	·4
Denmark	·08
Norway	·07

The weaving branch of the industry in England has been developed very much at the same rate as the spinning, having increased from 660,000 looms in 1905 to 750,000 in 1914.

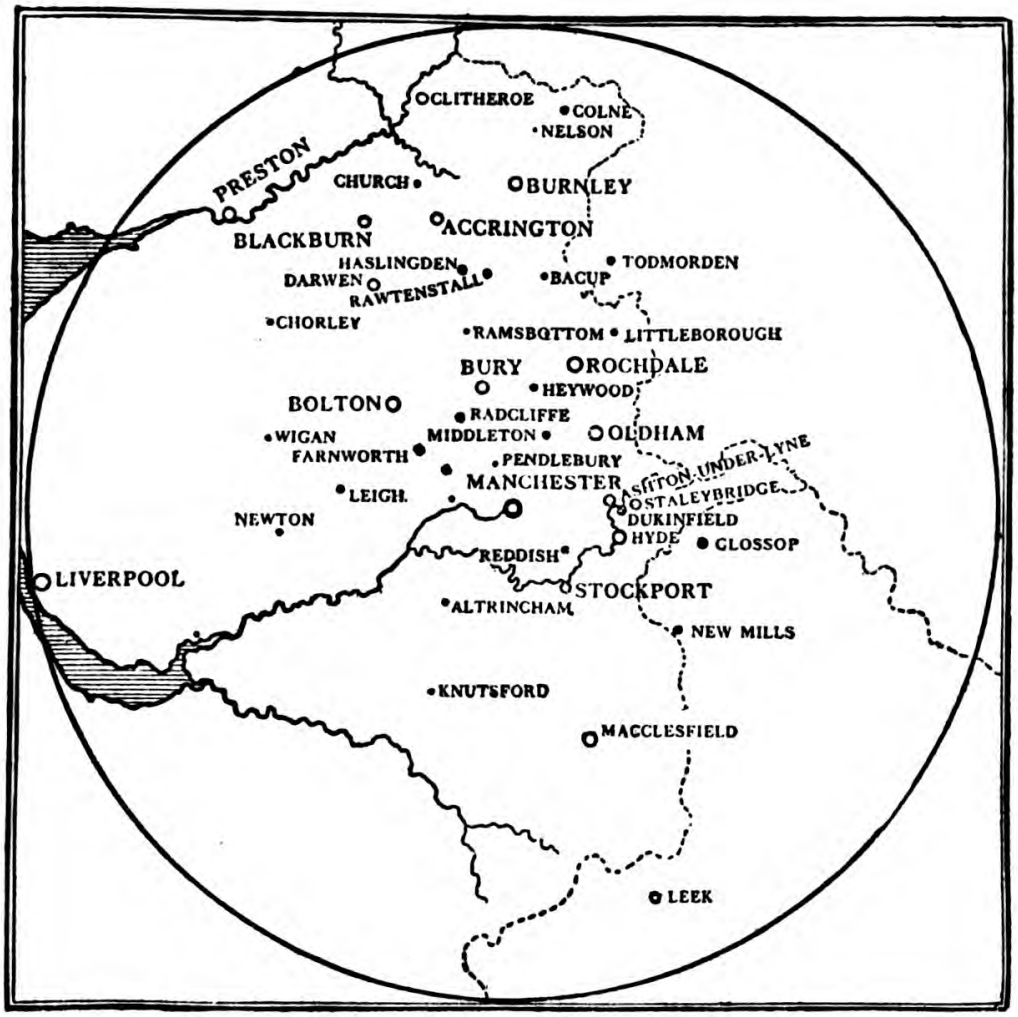
A curious fact in connection with the Lancashire cotton industry has been the tendency for spinning and weaving to be carried on separately. In recent years spinning has chiefly developed in the districts of Oldham, Bolton, Ashton, and Rochdale; whilst weaving has gravitated more and more towards such towns as Blackburn, Burnley, Preston, and Nelson.

Another peculiarity is that different districts specialize in different classes of work; Blackburn is famous for shirtings, Burnley for printing cloth, Nelson for sateens, and so on.

In addition to the processes of spinning and weaving, which employ considerably over 600,000 people, there are numerous subsidiary and dependent industries such as bleaching, dyeing, finishing, calico printing, ready-made clothing, and many others, which give employment to an enormous additional number of workers.

Marketing Facilities.—On the Manchester Exchange a manufacturer can buy at a moment's notice every class of yarn that he needs to execute his orders, and but a comparatively short journey brings him from his factory to the Exchange. Such a highly developed marketing centre cannot be suddenly created. It is a gradual growth. As Manchester improved its marketing facilities, spinning and weaving were divorced and pushed out of Manchester. To make the marketing facilities accessible and provide for cheap and rapid carriage of the goods bought, transportation had to improve. To-day, Lancashire is served with a bewildering network of railways, managed from Manchester. Again, a vast industry needs credit. This, too, in Lancashire has become a local product. Powerful local banks have their head offices in Manchester and numerous branches in the neighbouring towns.

Foreign Trade.—There is no country on the face of the globe to which the finished products of the British textile industries do not find their way. Indeed, important as is the home trade, it is the export trade which is of infinitely greater importance. This



COTTON AREA

will be understood at once when it is realized that of the £230,000,000 worth of goods produced in 1907, according to the Census of Production, no less than £164,000,000 were exported from these shores. In other words, over 70 per cent. of the total output left British ports to find markets in other lands.

2. Flax. (Fr. *Lin*, Ger. *Lein, Flachs*, Sp. *Lino.*)

Flax is a fibre which is produced from a species of tree which flourishes on soil fertilized by decayed vegetable matter. From

the earliest known times it has furnished the raw material out of which linen is made, traces of it having been found in Swiss lake dwellings; whilst the mummy-cloths bear witness to its use in ancient Egypt. It grows largely in Russia, Saxony, Belgium, Holland, Italy, and the north of France. In the United Kingdom its growth has declined, though there are still considerable crops raised in Ireland. For our linen manufactures, therefore, we are almost entirely dependent upon the flax imported from various continental countries, the largest supply coming from Russia.

In the preparation of flax for manufacture into cloth, or flax-dressing, as it is called, the following method is adopted. The stems of the plant are either cut or pulled up by the roots and allowed to dry. After the seeds have been removed by a process known as rippling, the flax is subjected to what is called retting. The stalks or stems are steeped in water and fermentation sets in, the result being that the fibres are freed from the woody matter, and the gummy and glutinous matter is removed. This part of the work is now generally carried out by a special process known as Pownall's. After being removed from the vats and allowed to dry in the open air, the flax is scutched, that is, placed in a machine called a scutching machine, when the work of complete separation of the fibre from the woody matter is completed. The fibre is then ready for being made into linen. It is from the finest flax that the well-known Brussels lace is made.

The seeds of the common flax plant are used for the manufacture of linseed oil, and the crushed seeds are made into oil-cake and linseed meal. When linseed oil is mixed with boiling water, carron oil, a substance often used for treating burns, is obtained.

The New Zealand flax is very different from and superior to the European flax, its fibre being beautifully fine, strong, and silky. Owing to the presence of a large amount of gummy and resinous matter it is not easy to prepare it for commercial usage.

The figures of flax consumption show a considerable decline in the last thirty years. In 1880 the quantity of flax consumed was as much as $2\frac{1}{3}$ million cwt., a figure which has never since been reached. The chief sources of flax consumed in the British Isles are Russia and Belgium.

3. Hemp. (Fr. *Chanvre*, Ger. *Hanf*, Sp. *Cáñamo.*)

Hemp is the name applied to various vegetable substances

cultivated on account of their fibre, but principally to the *Cannabis sativa*, a native of Central Asia, though now widely distributed over Asia, Europe, and Africa. The hemp fibre is obtained from the bark after long steeping in water. Hemp, dressed and undressed, is a most important article of commerce, and there are very large exports to various parts of the world from Russia, Germany, and Italy. The finest hemp is produced by the last-mentioned country. It is specially employed for the weaving of cloth and the manufacture of thread, rope, and cordage. In India, hemp is grown not so much on account of its fibre, but for the narcotic obtained from a resinous secretion. From hemp seed an illuminating oil can be extracted by pressure. The oil is used by the Russian peasantry. It is also employed in the manufacture of paints, varnishes, and some kinds of soft soap. The residue obtained after the extraction of the oil is compressed into an oil-cake for the feeding of cattle, while the grain itself is a food for birds.

4. Jute. (Fr. *Jute, chanvre de l' Inde*, Ger. *Jute, Jutehanf*, Sp. *Cáñamo de las Indias.*)

Jute is an important Indian fibre, obtained mainly in Calcutta from two very similar species of plants. The fibre is the inner bark of the plant, and is separated from the woody stalk by steeping in water. Sometimes the jute is placed in rivers, but more generally in tanks or stagnant pools. Previous to steeping, the stalks are stacked for a few days, in order to allow the leaves to decay. After the separation, the fibre is washed in water, then dried in the sun, and afterwards done up in small bundles. In Calcutta it is pressed into bales for exportation, and shipped in enormous quantities to Dundee. The best qualities of jute have a brownish yellow tint and a silky lustre. This colour is only discharged with great difficulty by bleaching. The fibre takes brilliant dye colours readily, but they are somewhat fugitive.

It is only within the last half century that jute has become so important an article of commerce. In India, the fibre had long been used for the manufacture of gunny bags and native clothing, but in Europe it was not much in favour until the great improvement in the spinning machinery made its working easy. Since 1850, Dundee, outside India, has had the greatest trade in the article. It is believed that, if some better method could be

discovered of separating the fibre from the stalk, the quality of the jute manufactures would be vastly improved.

In Dundee, the most common fabrics made from jute are sackings, mattings, tarpaulins, floorcloths, and inferior classes of carpets. Millions of small, brightly-dyed prayer carpets for Mahometans are exported from Dundee. On account of its glossy nature, jute has been much used in adulterating or imitating silk textures. It is also employed in the manufacture of stage wigs, tresses, and ladies' hair pads.

The processes of preparing, spinning, and weaving jute are very similar to those used for flax, but the machinery required is of a heavier description.

The British jute industry, like the cotton, is entirely dependent on imported supplies, with the special feature that those supplies are practically obtainable from one source only—India. The average annual imports of jute amount to nearly 250,000 tons, although the supply is subject to rapid and extensive fluctuations. Before its introduction into Great Britain, the jute fibre was used by the natives of India for a considerable number of years, probably for a few centuries, in the manufacture of twine, ropes, and coarse fabrics. These articles were used for the fishing industry, for mooring small vessels, for clothing, and other purposes, and the native demand for the fibre for these articles found employment for a number of agricultural labourers and farmers. When it became known that coarse fabrics could be made more quickly and cheaply by machinery, a demand arose for these cloths for all kinds of purposes—demands which grew year by year and which necessitated an increase in the area planted.

This progressive demand has quite revolutionized certain districts in Bengal and Assam to such an extent that for a number of years there have been more than 3 million acres of land annually under cultivation for the jute fibre alone. More or less constant work is thus found for large numbers of workpeople, independent of those who are actually engaged in the manufacture of the yarns and fabrics in the vicinity of Calcutta.

There are two well-known varieties of jute plants, one of which is chiefly cultivated in the northern districts, while the other is grown principally in the low land near the delta of the Hooghly. The best fibre is obtained from the plants which grow on the high lands.

There are from 4,000,000 to 5,000,000 bales of jute per annum shipped from India to various parts of the world, and about the same number of bales used in the Indian jute mills.

The annual estimated consumption in the various countries before the war is as follows—

ESTIMATED CONSUMPTION OF JUTE BY THE LEADING COUNTRIES.

Country.	*No. of Bales.*	*Country.*	*No. of Bales.*
Scotland . .	1,300,000	Norway & Sweden	60,000
England . .	20,000	Russia . .	230,000
Ireland . .	25,000	Holland . .	30,000
France . .	620,000	Spain . .	150,000
Belgium . .	150,000	Italy . . .	250,000
Germany . .	800,000	America . .	600,000
Austria & Bohemia	320,000	India . . .	4,500,000

The cloth made from jute has been called the " world's wrapper." It covers the world's supply of cotton and of wool from the fields and farms across the seas to the markets and mills in this and other countries. It protects all textile products from the mills to the warehouses and shops. Bags and sacks of all shapes, sizes, and qualities are made in enormous quantities; whilst jute yarns are also used to form the back of nearly all Brussels, Wilton, and Axminster carpets, and an endless variety of fancy rugs and mats. In short, the number of purposes for which jute is used is legion.

5. Esparto. (Fr. *Sparte,* Ger. *Esparto, Spartogras,* Sp. *Esparto.*)

This is a species of grass found in the various countries bordering on the Mediterranean Sea. It has long been used for the manufacture of carpets, ropes, baskets, nets, etc., but its chief application in modern times has been for paper-making. There are very large exports from Algiers to Great Britain, and it is estimated that this country takes altogether over 150,000 tons per annum. The grass grows wild, and does not require much rain. Owing to waste and destruction in cutting and pulling up the plant, Governmental regulations have been issued in both Algiers and Spain as to its cultivation and treatment.

TEST PAPER XVII

1. Give the names and sources of the chief textile materials and the distribution of the main regions from which they are exported. Account for their distribution.

2. Describe the development and present position of the world supply of raw cotton.

3. Write short notes on: flax, hemp, jute, and esparto.

CHAPTER XI

CAOUTCHOUC AND GUTTA-PERCHA

1. Caoutchouc. (Fr. *Caoutchouc*, Ger. *Federharz, Kautschuk*, Sp. *Resina elástica.*)

This is an important elastic gum, commonly known as india-rubber. It is the sap or juice obtained from a variety of trees growing in the tropics. When the sap or juice flows, it is like thin cream, but it gradually thickens upon exposure to the air. A mould of wood is then dipped into the juice, and exposed to the heat and smoke of a wood fire. The layer obtained coagulates, and this process is continued until the mass has attained the requisite thickness. The mould is then removed, and the india-rubber, or caoutchouc, is dried before being sent into the market. The principal supplies are obtained from Brazil.

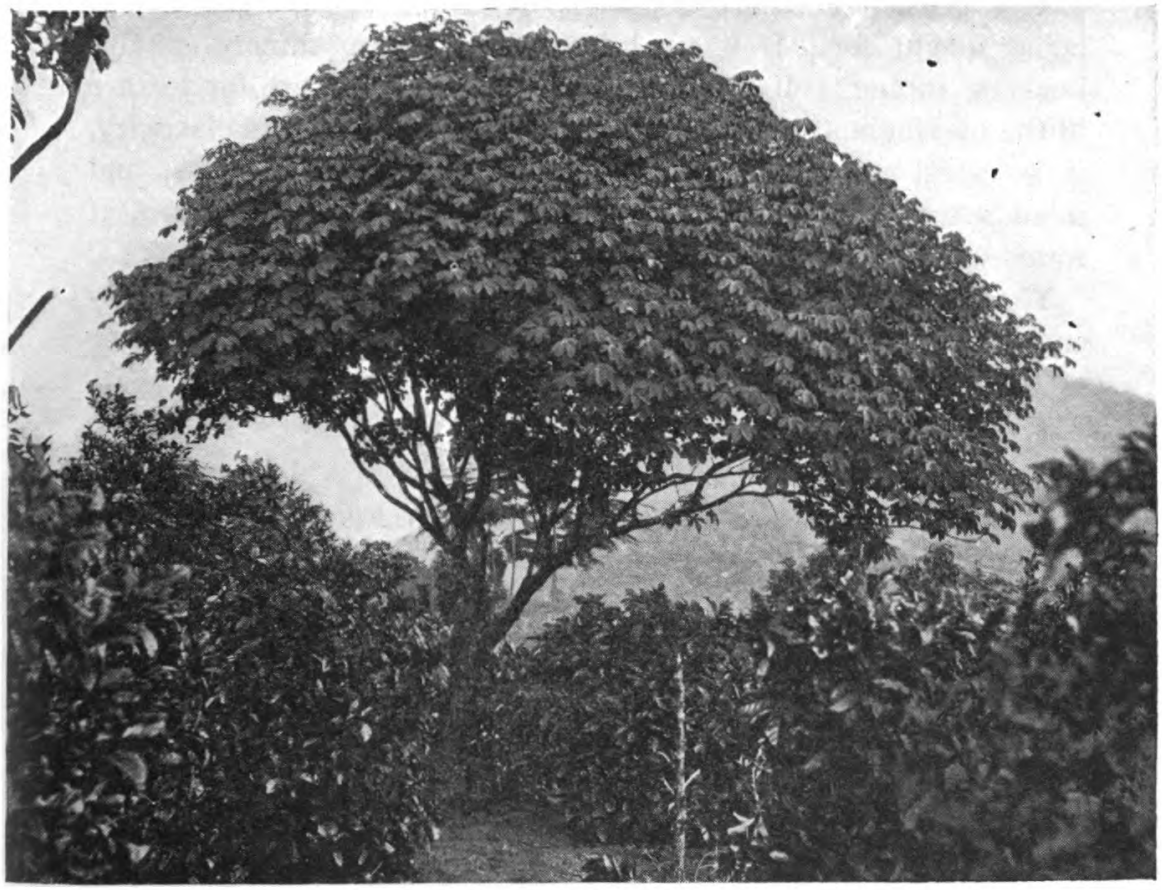
Caoutchouc is a pure hydrocarbon. When carefully prepared it is white, but usually it has a brown or brownish-black colour. It is lighter than water, and, though it does not dissolve in water, it is soluble in essential oil and other solvents. It is tenacious and elastic, being very soft and pliant when gently warmed. It burns with a bright smoky flame and gives out a most unpleasant odour.

Vulcanized caoutchouc is a mixture of caoutchouc and flowers of sulphur, or sulphide of antimony. The mixture is exposed to a high temperature for a few hours, when an entirely new substance is produced. This vulcanization renders the caoutchouc more elastic and less porous, and especially valuable for manufacturing purposes. If the quantity of sulphur is increased and the temperature raised higher, a hard black horny substance called ebonite, or vulcanite, is the result.

Caoutchouc, either alone or modified, is used for an immense number of purposes. Amongst these may be mentioned springs and buffers, gas and water pipes, fire hose, door mats, dolls, machine belting, all sorts of waterproof coverings, cushions, beds, etc. Vulcanite or ebonite is employed in the manufacture of electrical appliances, combs, chemical apparatus, stethoscopes, speaking tubes, etc., and generally of those articles which cannot be made of horn or whalebone.

2. Gutta-percha. (Fr. and Ger. *Gutta-percha*, Sp. *Gutaperca*.)

This is a substance resembling india-rubber in many respects, and often confounded with it in the public mind. The great difference between the two consists in the fact that gutta-percha is non-elastic, while india-rubber is elastic. Gutta-percha is the



CEARA RUBBER TREE

exudation of many species of trees, which grow extensively in Sumatra, Borneo, and other East Indian Islands, whence the whole supply of gutta-percha is obtained. The milky juice which comes from the tree hardens very quickly on exposure to the air. It is then of a brownish-red colour, though this is owing mainly to the presence of various impurities, for purified gutta-percha is of a greyish-white colour. At ordinary temperatures, it is hard and tough as wood, but as the temperature rises it becomes softer and can be spread out into cakes. Before being

used in manufactures, it is purified and kneaded by powerful machinery with the aid of hot water and bleaching carbon. It is a hydrocarbon and soluble in benzine and bisulphide of carbon. Its uses are exceedingly numerous. Being a non-conductor of electricity, it is extensively employed as a covering for telegraph wires and for other insulating processes. Unfortunately, it is not a very lasting substance, and a substitute of greater stability is being sought for It is used for belting for machinery, pump-buckets, tubing, golf balls, and as a cheap substitute for leather in the making and mending of boots. On account of its plasticity, it is useful for taking impressions of seals, medals, coins, and moulds generally. When dissolved in bisulphide of carbon, it forms a useful cement.

The amount of the imports and the price of gutta-percha vary enormously, and difficulty is occasioned by the wasteful cutting of the trees by the natives.

TEST PAPER XVIII

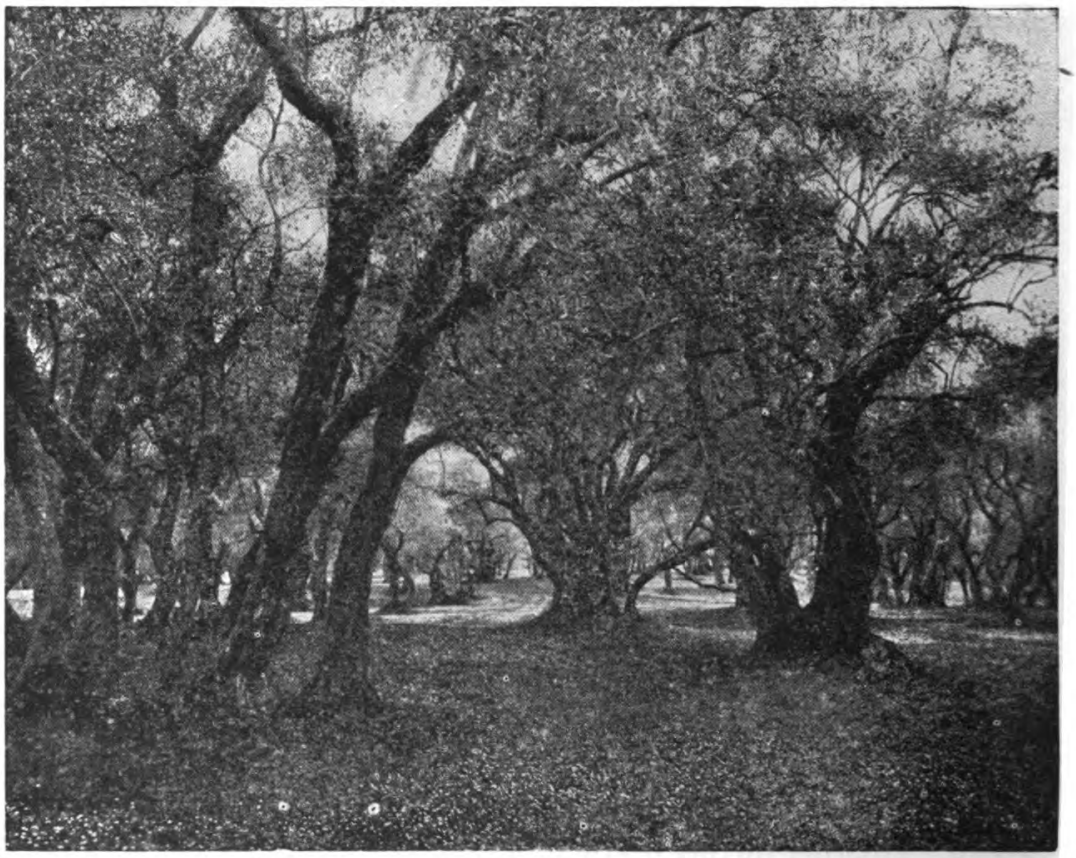
1. Write an account of Caoutchouc under the following heads—
   (*a*) Sources of supply.
   (*b*) Chief characteristics.
   (*c*) Uses.
2. What is the difference between india-rubber and gutta-percha ?
3. Give an account of the chief uses of gutta-percha.

CHAPTER XII

VEGETABLE OILS

THE term "oil" is applied generally to all fluid substances of whatever nature which flow with a certain degree of viscosity, They are divided into two main groups, fixed oils and volatile or essential oils. The latter are generally obtained by distilling the leaves, flowers, etc., of plants with water. Their principal ingredients are hydrocarbon closely allied to turpentine, together with small quantities of oxidized products and resins. They are inflammable, leave a greasy mark on paper, which is removed by warming, feel harsh when rubbed on the skin, and may be distilled without undergoing much change. Most essential oils have a powerful odour, which varies according to the nature of the plant from which it is obtained. Among the principal oils of this class are those of lemon, orange, juniper, peppermint, and cloves. Fixed oils cannot be distilled without undergoing decomposition. They are inflammable, leave a permanent stain on paper, and have an oily feel when applied to the skin. They are divided into the two classes of animal and vegetable oils, according to their origin. The former are obtained from various animal fats by pressure and heat, or by allowing the oil to drain away; the latter are obtained from seeds by powerful pressure. Both classes consist largely of glycerides, that is, compounds of glycerine with stearic, palmitic, oleic, and similar acids, and undergo saponification when treated with an alkali. Another further division of fixed oils is into those of drying and non-drying oils. The former become solid when exposed to the air, the latter do not. Drying oils are mainly used for mixing painters' colours, the principal of these being linseed, poppy, hemp, grape-seed, honesty, castor, cotton seed, and croton. The non-drying are employed for the purposes of illuminating and soap-making, and the chief of these are olive, almond, ben, laurel, rape, palm, spurge, and candle-nut. The drying of the drying oils is due to the absorption of oxygen, and the formation of oxidized products. The other uses of oils are very numerous, and some of these are noticed under separate heads.

A most important group of products is the valuable series of oil-seeds and oil-yielding nuts, chief of which from the point of view of the British manufacturer are copra and palm kernels, cotton seed, linseed, rape-seed, and castor seed. Of less interest in this country, because they have not yet been utilized to any extent, but of great importance in other countries, particularly France, are ground nuts, Sesamum seed, and poppy seed.



OLIVE TREES

There are many uses for these vegetable oils, but perhaps that of the greatest importance is the manufacture of margarine. For this purpose, in the United Kingdom, coconut oil, palm kernel oil, and refined rape-seed oil are at present principally used.

1. Olive. (Fr. and Ger. *Olive*, Sp. *Oliva*.)

A genus of trees or shrubs of which there are about thirty species widely distributed over the warmer temperate regions of the globe. The common olive, *Olea Europea*, is a native of Syria, but it is

found in all parts of southern Europe. The unripe fruit is pickled and consumed both in the countries where the olive is found and abroad. The best pickled olives imported by Great Britain are obtained from Genoa and Marseilles, but good qualities are sent out from Leghorn and Naples. The wood of the olive is used by cabinet makers. The most important product of the olive is olive oil. This substance is the cream and butter of Italy and Spain. The oil is contained in the fleshy parts of the fruit and is extracted by pressure. There are three qualities. For the first, the fruit is placed in woollen bags and a slight pressure applied. The oil thus obtained is the virgin olive oil, and is of the finest quality. The remaining pulp is moistened with water and by repeating the pressure, though to a greater extent, the second class of olive oil is obtained. A third steeping in water and a further pressure gives the third class of oil. The first two are useful and fit for domestic purposes, the third only for manufacturing processes. The best olive oil is made in Tuscany, and Italy is the chief exporting country.

2. Sesame. (Fr. *Sésame,* Ger. *Sesam,* Sp. *Sésamo.*)

The herb of the genus *Sesamum,* commonly cultivated throughout the East on account of its seeds, which produce gingili oil, a pale, straw-coloured, sweet oil which is used for perfumery and also as a substitute for olive oil. Both the seeds and the oil are extensively imported into Europe.

3. Rape Seed. (Fr. *Grain de colza,* Ger. *Rübsamen,* Sp. *Nabina.*)

One of the most important oil seeds of Russia and India, obtained from the *brassica rapa* and the *brassica campestris,* two plants of the same order as the cabbage. The rape, which is also known as coleseed, is now grown extensively in Britain. The rape or colza oil of commerce is obtained by crushing the seed, and is used extensively for oiling machinery and for burning in lamps. Rape cake is the residue after the oil has been extracted and forms a good feeding stuff for cattle, though it is inferior to linseed cake. When crushed, the cake is a valuable manure.

4. Palm Oil. (Fr. *Huile de Palme,* Ger. *Palmöl,* Sp. *Aceite de Palma.*)

This is derived from a tree belonging to the palm order, of which the Guinea oil palm is the most important. It is a low-growing

species abounding in tropical West Africa. The fruits from which the oil is obtained are borne in dense heads, and the seeds are enclosed in a hard bone-like shell of a yellow colour. The fruits are first boiled and then crushed in mortars. They are then placed in large vats filled with water, and the oil is trodden out and comes to the surface. After collecting and boiling, to get rid of some of the water, the oil is ready for exportation. The best palm oil has the consistence of butter, and is yellow in colour. When fresh its smell is exceedingly agreeable. In Africa, the natives use the substance for culinary purposes. In Europe, palm oil is employed very extensively in the manufacture of candles and soap, and for greasing the axles of railway carriage wheels. The export of palm oil is perhaps the greatest of the West African industries.

5. Linseed Oil. (Fr. *Huile de Lin*, Ger. *Leinol*, Sp. *Acetite de Linaza.*)

This is obtained from an important oil seed—the seed of the flax plant—which is exported largely from India, the East Indies, and Russia. For the extraction of the oil, the seeds are crushed and ground, and then subjected to enormous pressure. The oil, when quite pure, is colourless, but in commerce it is generally of an amber colour, and has a disagreeable odour and taste. It is much used in the manufacture of paints, varnishes, printing ink, oil-cloths, etc., on account of its drying qualities. The cake left after the expression of the oil is valuable as a cattle food. Linseed meal, which is composed of the flour of the ground flax seed or crushed oilcake, is useful for poultices on account of its powerful emollient properties. An infusion of linseed is employed in cases of colds and bronchial affections.

6. Cottonseed Oil. (Fr. *Huile de graine de coton*, Ger. *Baumwoll-camenol.*)

This is a refined oil which is the main product of the cotton seed. It is used for a great number of purposes, such as a substitute for olive oil, mixed with beef products for preparation of compound lard, which is estimated to consume one-third of the cottonseed oil produced in the United States. The poorer grades are employed in the manufacture of soap, candles, and phonograph records.

TEST PAPER XIX

1. Into what main groups may " oils " be sub-divided ?
2. State the characteristics of fixed oils and essential oils.
3. Enumerate the principal vegetable oils which enter into commerce.
4. Write short notes on olive oil, sesame oil, palm oil and linseed oil.

CHAPTER XIII

TIMBER

TIMBER consists of the firm and older formations of trees and shrubs which in a dry state are used as fuel. In accordance with their nature, a distinction is drawn between deciduous, coniferous, and mixed forests.

Deciduous trees and the larches amongst the coniferous trees lose their leaves in the autumn and grow new ones in the following spring. The evergreen trees and shrubs of the warmer countries likewise change their leaves, but this change is gradual and imperceptible, and is not tied to any particular season of the year.

The most suitable time for the felling of trees is the winter, when the circulation of the sap and the growth of the tree are quiescent and when the necessary labour is available. The principal uses to which timber is put are for building and manufacturing purposes, as well as for mining props. Almost any kind of timber will serve as fuel, and coal owes its origin to plant life, so that the most important supplies of fuel emanate from the forests.

A comparatively new and very important employment of timber consists in its conversion into paper; and with the increased shortage in the supplies of such raw materials as rags and straw, many cellulose factories have arisen for the conversion of wood into paper pulp.

The part of the world richest in forests is the Northern hemisphere, especially the United States, and Canada in North America; Russia, Finland, Germany, and Austria in Europe; Southern Siberia and Japan in Asia.

In the deciduous forests, beeches and oaks take the premier position both as regards beauty and economic importance. The smooth barked beech, with its multitude of branches and rich foliage, is the most prominent shade given in the forests of Central Europe, and at the same time it furnishes the most plentiful manure; whilst the oak, with its fissured bark and its powerful branches, appears the very embodiment of strength, and furnishes

By permission of the *"Timber Trades Journal."*

FIR TIMBER FROM NORTHERN FORESTS. READY FOR THE MILLS AT RIGA

an exceedingly strong wood, which is used both for cabinet-making and as tanning material. The number of species of deciduous trees greatly exceeds that of coniferous trees. In addition to the beech and the oak, mention should be made of the birch, the poplar, the ash, and the elm. Among the most important deciduous trees of the Mediterranean are to be included the olive and the box tree.

The whole of the deciduous trees are of less value, in regard to usefulness, than the coniferous species. This is due to various reasons. As a rule, the latter grow much more rapidly, have perfectly straight trunks with few branches. They make few demands upon the climate and soil, and, in addition to timber, they also furnish turpentine and resins. Furthermore, coniferous trees are soft and can easily be worked, and for this reason they are largely used in the manufacture of paper pulp.

In the southern hemisphere no country is so favoured, in regard to climate and soil, for the growth of forests as New Zealand. The British and Colonial Exhibition in London in 1910 showed samples of the twenty-four most important timbers of this group of islands. The first place is occupied by the *kauri fir*, a tremendous tree, which is frequently found as old as 1,500 to 3,000 years. This tree has a slower growth than most other conifers, but its wood is stronger, lighter, more elastic and durable, and is especially suitable for cabinet-making and shipbuilding.

1. Fir. (Fr. *Sapin*, Ger. *Fichte, Tanne*, Sp. *Pino.*)

This is a comprehensive name for many species of trees belonging to the order *Coniferae.* For the most part they are lofty and hardy, and their leaves are evergreen. One of the best known is the Norway spruce, which penetrates within the Arctic circle. It yields various products, such as resin, turpentine, tar, and lamp-black. The resin is called frankincense. The timber is largely exported under the name of " white deal." Another species is the Canadian fir, from which " Canada balsam " is obtained. The only pine now native in Britain is the Scottish fir, and this yields the wood known as yellow deal, and tar by distillation.

2. Oak. (Fr. *Chene*, Ger. *Eiche*, Sp. *Encina.*)

The timber of several species of *Quercus.* There are between 250 and 300 species of this tree growing widely within the tropics

and the temperate zone. In England the principal of these is the common oak. The timber is remarkable for its strength and durability, and, as it is impervious to water, it is admirably adapted for shipbuilding. Large supplies are obtained from foreign countries especially America, where the tree in greatest esteem is the white oak. The bark is admirably adapted for tanning purposes, and is the principal substance used by curriers in Great Britain.

3. Teak. (Fr. *Teck, tek,* Ger. *Te(a)k-holz,* Sp. *Teca, encina de Africa.*)

This is the hard and durable timber of the *Tectona grandis,* a gigantic tree of India and the East Indies. Teak is particularly prized for shipbuilding and the construction of bridges, as the possession of some oil or substance in its constituents prevents the rusting and corrosion of iron when that metal is placed in contact with it. It is also used for the making of railway carriages, furniture, etc. The leaves of the tree yield a red dye.

4. Beech. (Fr. *Hetre,* Ger. *Buche,* Sp. *Haya.*)

The *Fagus sylvatica,* one of the common trees of Europe, cultivated on account of the usefulness of its wood for many domestic purposes. The wood is whitish-brown in colour, and has a silky grain. It is durable under water, although not in varied conditions. Amongst the domestic articles which are manufactured from beech are chairs, tables, bedsteads, bowls, ladles, carpenters' planes, and other tools. It is also in great demand by wheelwrights and coachbuilders.

5. Mahogany. (Fr. *Acajou, mahogon,* Ger. *Mahogoniholz,* Sp. *Caoba.*)

A very valuable and beautiful timber, obtained from the *Swietenia mahogani,* a tall and beautiful tree of the West Indies and Central America. The wood is of a close texture, reddish brown in colour, and takes a fine polish. It is also free from warping. The value of the wood, which is mainly used in the manufacture of furniture, varies according to its colour and markings. The largest supplies are obtained from Honduras, Campeachy, and the West India Islands generally. That of Honduras and Campeachy is known as bay wood, that of Cuba and Hayti as Spanish mahogany.

6. Elm. (Fr. *Orme*, Ger. *Ulme*, Sp. *Olmo.*)

A genus of trees belonging to the order *Ulmaceae.* The trees grow in all parts of Europe, and there are many fine varieties in England. The wood of the English elm is valuable on account of its strength, toughness, and durability. It is not so liable to split as other timber, and resists the action of water. Hence it is much employed in shipbuilding and for making foundation piles. The common and the Cornish elms are considered to give the best timber.

7. Box Wood. (Fr. *Bois de buis*, Ger. *Buchsbaumholz*, Sp. *Madera de boj.*)

The wood of the box tree, which is now cultivated in many parts of Europe and Asia. It is close-grained, smooth and remarkably hard and strong. The wood has a yellowish colour and is capable of taking a beautiful polish. Not only is it much in request by the wood engraver and the turner, but it is extremely valuable in the manufacture of musical and mathematical instruments.

TEST PAPER XX

1. Distinguish between—
   (*a*) Deciduous trees; and
   (*b*) Coniferous trees.
   Which are the more important for commercial purposes ?

2. Where are the world's richest forests to be found ? Account for their distribution.

3. Write short notes on fir, oak, teak, and mahogany.

4. Mention the characteristics of box-wood, and say for what purposes it is largely used.

SECTION IV

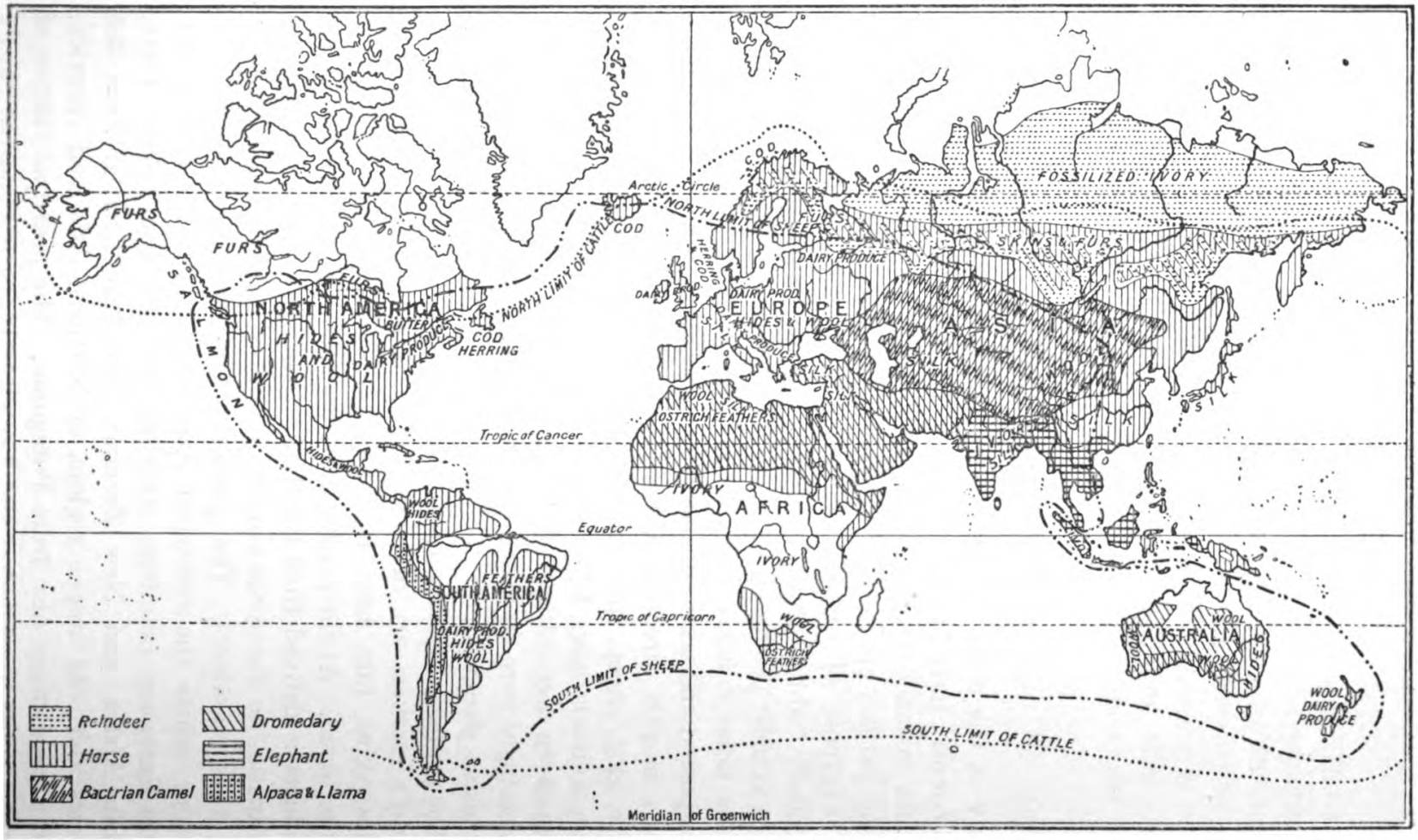
THE ANIMAL KINGDOM

CHAPTER I

GENERAL SURVEY

MANY of the conditions which exercise an influence on the flora of a country have likewise an important effect upon its fauna; such are, for instance, rainfall, soil, and temperature. The distribution of the various species of animals depends in the first place upon the existence of suitable nourishment. Some animals are very migratory, whilst others are restricted to certain districts. The fauna is most prolific in the tropical regions and most monotonous in the polar countries. It frequently happens that animals are transported and acclimatized in other districts by man, and experiments in this direction are greatly on the increase. The cow, horse, dog, sheep, and goat are very widely distributed, whilst other animals have become extinct, as, for instance, most wild animals in agricultural districts. Fur-bearing animals become increasingly rare in North America and Siberia owing to their extensive slaughter.

The products of the animal kingdom which are brought into the world's markets are of incalculable value. Trade in meat, fat, hides, skins, furs, hair, feathers, etc., takes place in every part of the world. At the present time the chief supply of stock-rearing products is derived from South America, and, with the exception of Russia, no European country can now supply its own demand for these products. The production of wool has spread from Europe, where the renowned Spanish supplies have declined, to extra-European countries such as Australia, the River Plate, South Africa, and New Zealand. Furs are derived from the forests and cold steppe regions of Northern Asia and America, and a good many also from Patagonia. The principal centres of the fur trade are London and Leipzic. Ivory is exported chiefly



MAP SHOWING PRODUCTS OF THE ANIMAL KINGDOM

from South Africa (*e.g.*, Zanzibar), as also are ostrich feathers; eiderdown comes largely from Norway and Iceland, whilst guano is obtained chiefly from Peru. Among insects, the only ones of importance are the silk worm, the bee, and the cochineal.

The products of aquatic animals find as varied a use as those of land animals, but the former excel by their huge quantities. Fish are much more migratory than the mammalia of the land and birds. Fishing on a large scale takes place in all parts of the ocean, and it is important not only because of the number of persons it employs but also it constitutes the training ground of good seamen. The output of certain species of fish depends largely upon the uncertainties of the wind and the weather. Whale fishing is of the greatest importance in the Pacific Ocean, the islanders of which have adopted European customs from the whale hunters. In the northern Atlantic, however, haddock fishing is of greater importance than whaling. The centres of the haddock fishery are located on the east coast of North America, in the vicinity of Newfoundland, Cape Breton, Nova Scotia, Labrador, and in Norway on the European side of the ocean. On the coast of Scotland, the herring fishery finds abundant scope for employment. English, Scotch, Dutch, and German fishermen all share in the catch. Coral fishing is restricted to the Mediterranean; pearl fishing is carried on in the Red Sea, the Persian Gulf, the coasts of southern India, and in the Gulf of California.

Animal products, like those of the vegetable kingdom, are chiefly used for the provision of food and clothing. However, they are more highly organized and more simply constructed in their chemical composition than many vegetable substances which serve the same purposes. Compare, for instance, the textile materials from the animal kingdom, such as wool and silk, with those of the vegetable kingdom, such as cotton and flax. It has already been seen that the latter class consist of cellulose (*i.e.*, carbon, hydrogen, and oxygen) similar to starch and sugar. The animal textile materials, however, whether it be the hair of the higher animals or the webs of worms or spiders, differ in so far that they contain nitrogen in addition to the above elements, whilst wool also contains sulphur. Wool contains 49·25 per cent. of carbon, 23·6 per cent. of oxygen, 15·57 per cent. of nitrogen, 7·57 per cent. of hydrogen, and 3·66 per cent. of sulphur. The

sulphur contained in the hair of animals is the cause of its disagreeable odour when burning. Moreover, it is also the reason why wool, when treated with a solution of sugar of lead, turns black, whilst silk and the spider's web do not show this characteristic. Textiles made from the hair of animals are worse conductors of heat than clothes made from vegetable fibre. The application of picric acid turns the former yellow, but this is not the case in regard to vegetable fibre.

Even more complex than their chemical composition is the structure of animal products. Foodstuffs drawn from the vegetable kingdom may be kept much longer without special preparation than animal foodstuffs, which very soon undergo a chemical change and decay unless they are specially prepared (*i.e.*, salted or smoked) or kept in a low temperature. Exceptions to this rule, however, are those products in which the animal has no sense of feeling, such as the hair, feathers, horns, and the claws.

Animal products are chiefly derived from stock-rearing, but also to a smaller extent from hunting and fishing.

Stock-raising is the most widespread of the three sources of income derived from the animal kingdom, and satisfies a number of the most manifold human requirements, being intimately connected with agriculture.

Agriculture supplies the most important articles of food and clothing from the vegetable kingdom, whereas stock-raising tends to satisfy similar requirements from the animal kingdom. Cattle-raising is carried on in manifold forms, and amongst nomadic peoples it forms the transitional occupation from the primitive to a more civilized state. Natural man lives by hunting and fishing, and upon the edible roots and fruits of the forests. The aim and direction of his nomadic life are always determined by his search for food and water, as well as by a desire to procure shelter against the inclemency of the weather. For these reasons, he can never tarry long in any particular spot in large numbers. He has neither incitement nor time for higher mental activity. A further and more advanced stage of civilization is brought about by agriculture in conjunction with stock-raising.

Thus, agriculture ties man to a fixed abode and along with stock-raising it forms a sound basis for the development of a higher form of civilization. It is for this reason that the next chapter of this

section is devoted to a consideration of the products which are derived from stock-raising.

TEST PAPER XXI

1. Enumerate the chief animal products which are brought into the world's markets.
2. Name the chief centres of the fur trade.
3. Where are the world's chief fishing grounds ?
4. What are the principal uses of animal products ?

CHAPTER II

ANIMALS DERIVED FROM STOCK-RAISING

THE various kinds of animals which enter into consideration when dealing with stock-raising are known as domestic animals. These may be divided into large tame domesticated mammalia, small animals (*e.g.*, poultry, rabbits) and a small group recruited from the insect world, such as the silk worm, honey bee, etc. The large animals comprise the cow, sheep, goat, reindeer, camel, dromedary, llama, alpaca, vicuna; the horse, donkey, mule, etc.; the pig, elephant dog, and cat.

The use which man makes of these animals is manifold. They serve as beasts of burden, for riding, or for the drawing of vehicles, and they also supply valuable food in the shape of their milk and their flesh. Their hides serve for leather, their hair for clothing, and from their horns, bones, and intestines many articles of every-day use are manufactured. Finally, their excrements serve as manure or even as fuel in some districts which are poor in timber or coal.

1. Cattle. (Fr. *Bestiaux*, Ger. *Vieh*, Sp. *Ganado.*)

Amongst domestic animals, cattle stand in the forefront. The numerous breeds indicate that cattle have been associated with man from the very earliest times.

The method of cutting up cattle varies in different towns and countries. In the carcase of every animal there are various qualities of meat, and these are situated in different parts of the carcase.

In London, a cow's carcase is cut up into the following pieces, as shown in the diagram on page 123

Hind-quarter. Loin; rump; aitch or adze-bone; buttock; hock; thick flank and thin flank.

Fore-quarter. Fore-rib; middle-rib; chuck-rib; brisket; leg of mutton piece; clod and sticking and neck; shin and leg.

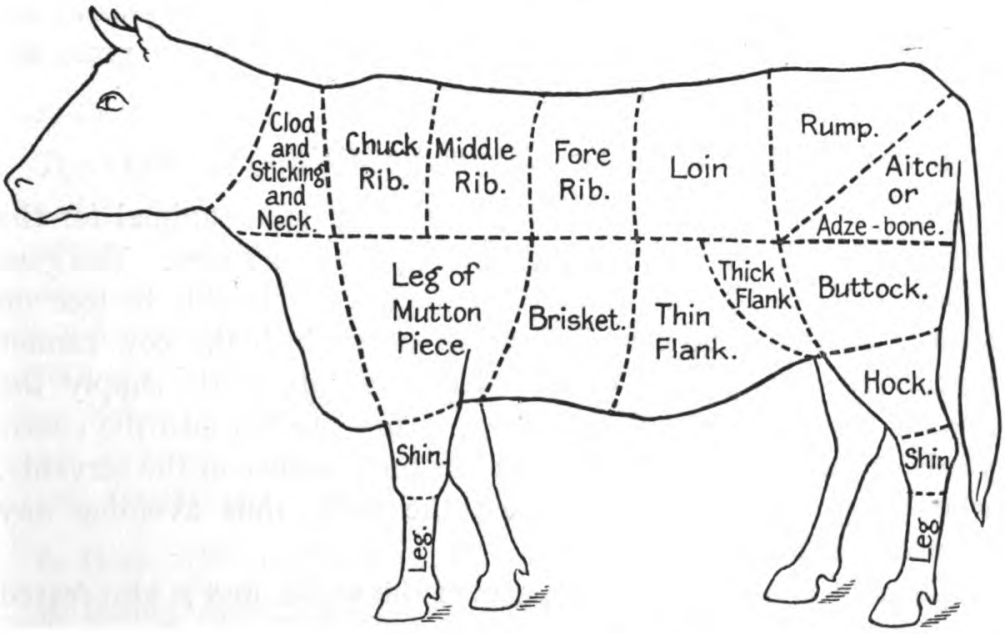
2. Sheep. (Fr. *Mouton*, Ger. *Schaf*, Sp. *Oveja.*)

The domestic animal second in importance is the sheep, the value of which consists of its wool and its flesh. It thrives best

in climates having much sunshine, provided there is plenty of pasture land and sufficient drinking water. There are many species of sheep—

(*a*) THE MERINO, or wandering sheep, which has a short neck and legs and very fine curly hair.

(*b*) THE SETTLED SHEEP.—During the reign of Charles III of Spain that country had about 5,000,000 merinos. Flocks



DISTRIBUTION OF ANIMAL

sometimes amounted to as many as 10,000 sheep pastured during the winter in the south, and in the spring they gradually migrated farther north. At the present time, with a stock of 13½ million sheep, less than 2 million belong to the merino breed, and the migrations have almost entirely ceased. In other parts of Europe there are numerous breeds of the common sheep, of which some are kept more for their wool, whilst others are kept rather for their meat. In France, at the Institute for Sheep-rearing in Rambouillet, very successful experiments were made with the crossing of breeds, as has also been the case in England. In Saxony likewise, experiments proved very successful as early as 1765, so that Saxon wool soon obtained a reputation throughout Europe and began to command high prices in the English market.

For some time the state of the market has been very favourable to sheep-raising on account of prevailing high prices, and for that reason sheep have been more valued than cattle.

Owing to the rapid consumption within the British Isles, the number of sheep has lessened considerably during the last thirty years, and living sheep are now imported from the Continent. Fresh mutton is also sent from the Continent, and frozen mutton comes from Australia and New Zealand. The chief supplies of wool derived from sheep comes from Australia. Sheep-skins for leather making, to the extent of about 15 millions a year, are obtained from South Africa and Australia.

3. Goats. (Fr. *Chevres*, Ger. *Ziegen*, Sp. *Cabras, Chivas.*)

Next to the cow, the goat is the most popular animal for the supply of milk, and is often called the poor man's cow. The goat is much easier to keep than the cow, since it is able to feed on almost anything and can climb up to spots which the cow cannot reach. In some towns of the Mediterranean, goats supply the greater part of the milk consumed. They are led into the court-yards of the customers and milked in the presence of the servants, who bring vessels for containing the milk, thus avoiding any chance of adulteration.

The goat is found in many parts of the world, and is also reared on account of its flesh, its skin, and its hair. In Europe, the largest numbers are reared in Spain, and the fewest in England, where the species are not considered of great value. The Angora and other Eastern goats are best known and are most highly prized. The skins of goats are tanned and employed in the manufacture of gloves and various kinds of leather. The United Kingdom imports the products of the goat from all parts of the world, the skins coming mainly from North Africa and India.

4. Horses. (Fr. *Chevaux*, Ger. *Pferde*, Sp., *Caballos.*)

Amongst single hoofed domestic animals, the horse is the most valuable. There are numerous breeds of this animal. The cross between a horse and a donkey, which generally follows more their sire, is stronger and bigger than the donkey. These mules, as they are called, are bred to a large extent in South America and

also in the United States, and they show themselves more tractable and stronger than the donkeys.

A large export and import trade is done by the United Kingdom in live horses, about 25,000 being annually imported and 20,000 exported under normal conditions. The largest number of animals comes from Germany. The hides, grease, and hair of horses are commercial products of vast importance, and more than 150,000 hides are received annually, principally for the manufacture of leather. The greater portion come from South America.

5. Dogs. (Fr. *Chiens*, Ger. *Hunde*, Sp. *Perros.*)

There is a very large trade carried on in dogs of various breeds, but it is the skin of the dog that is chiefly valued as a commercial product. The skins of the larger species can be tanned for boots, shoes, and riding gloves, while those of the smaller ones are used for the manufacture of lighter gloves. In China, dogs are reared on a large scale for the sake of their skins, some of the long-haired ones being turned into mats, coats, etc. The chief exporting town is New Chang, the value of the skins being estimated at about £50,000 per annum.

6. Deer. (Fr. *Cerfs*, Ger. *Reh, Rotwild*, Sp. *Corzo.*)

A family of ruminating mammals belonging to the order of hoofed quadrupeds. They are distinguished from other ruminants by the nature of their horns, or antlers, which are bony throughout, and are annually shed and reproduced. Deer are very widely distributed, and very many species are known, though none is found in Australia or Africa. The flesh appears in the market as venison, the horns are valuable in the manufacture of cutlery goods, and the skins are employed for making robes, rugs, and trimmings. India and South America are the principal sources from which Great Britain draws its supplies.

7. Pigs. (Fr. *Cochons*, Ger. *Schwein*, Sp. *Cochino.*)

Finally, we have to mention the pig. This animal is not so widely spread as the cow or sheep, nor are there so many breeds of it. It owes its breeding chiefly to its palatable meat, but the bristles are likewise a valuable commercial commodity obtained from it.

TEST PAPER XXII

1. Write a short essay on the uses of animals to man.

2. Copy the diagram on page 123, showing the way in which a cow's carcase is usually divided.

3. Name the chief domestic animals and state which you consider to be of the greatest service to man. Give reasons for your preference.

4. Write short notes on the goat, the pig, and the horse.

CHAPTER III

RANCHING PRODUCTS

1. Hides. (Fr. *Peaux, Cuirs,* Ger. *Häute, Felle,* Sp. *Pieles, Cueros.*)

The skins of large animals. They enter into commerce either as market hides, delivered direct from slaughter houses, or salted and dried hides imported from pastoral countries abroad in bundles or bales. They are divided into four grades—heavy, light extra, seconds, thirds. The slaughter houses of Great Britain supply about 3 million hides per annum, but the numbers imported are much greater. Russia, Holland, Belgium, and Italy are the principal European exporters, but most cow hides are obtained from South America and Australasia. Buffalo hides are imported into this country from India, horse hides from the River Plate, and a few heavy thick skins from Africa. They are used almost exclusively for the manufacture of leather and leather goods.

2. Skins. (Fr. *Peaux,* Ger. *Felle, Häute,* Sp. *Pieles.*)

The coverings of animals. The name is generally applied to the coverings of the smaller animals, those of the larger ones being known as hides.

The hides and skins used in heavy leather manufacture may be divided into three classes—

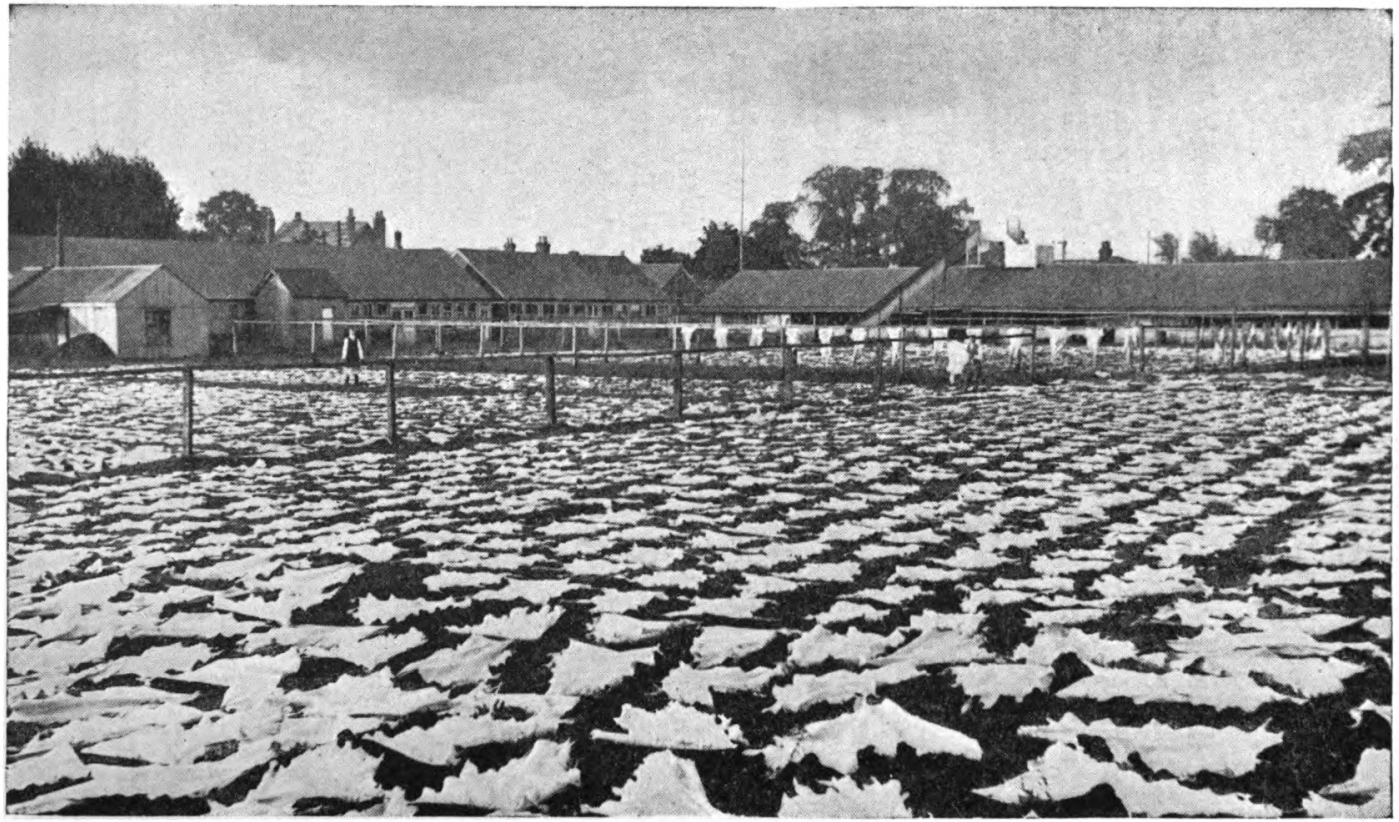
(1) Ox and heifer.
(2) Cow.
(3) Bull.

Oxen and heifer hides produce the best results, forming a tough, solid leather.

The chief sources of supply of hides and skins are Europe, the British Colonies, and South America.

3. Meat Extract. (Fr. *Extrait de viande,* Ger. *Fleischextract,* Sp. *Extracto de carne.*)

The concentrated essence of meat obtained by boiling down the carcases of oxen. A large number of these extracts are made in South America, and there are many well-known extracts made in Europe by peculiar processes, which are the secrets of their manufacturers. The trade in these substances is rapidly increasing.



BLEACHING OIL-TANNED LEATHER BY EXPOSURE TO THE SUN
(The Rosary Leather Mills, Ashtead)

4. Horns. (Fr. *Cornes*, Ger. *Hörner*, Sp. *Cuernos.*)

The hard-pointed excrescences growing on the heads of various animals, especially oxen, sheep, and goats. The antlers of the various kinds of deer are not horn. Besides the horns obtained in this country, Great Britain imports over 5,000 tons per annum, valued at more than £150,000. The largest supply is obtained from India, South America and the Cape being next in order. Horn is employed, according to its size, in the manufacture of a vast number of articles, ornamental and otherwise, cups, carvers, knife-handles, and umbrella handles being amongst the most common.

5. Leather. (Fr. *Cuir*, Ger. *Leder*, Sp. *Cuero.*)

The skins or hides of animals, especially the larger mammals, prepared by certain chemical processes so as to preserve them from decomposition and putrefaction, and to give them increased strength, toughness, and pliancy, together with insolubility in water. There are several distinct methods of preparing leather, but all depend upon the combination of the tannic acid of some tannin material with the gelatinous substance of which the skins or hides are largely composed. The skins of all animals can be made into leather, but in practice only a limited number are utilized. Besides those skins and hides obtained from local slaughter-houses there are enormous annual supplies imported from Australia, South Africa, and South America. Buffalo hides are exported by the East Indies, horse hides are obtained from South America, and goat skins and kid skins from the Cape, Switzerland, and Asia Minor.

In the preparation of leather the hides are first steeped in water, and allowed to soak for some time, so as to get rid of all blood, salt, and other extraneous substances. The hair is next loosened and removed, and whatever fat remains is taken away by the action of lime-water and sulphide of sodium. In America, a plan of sweating the hides is adopted instead of steeping them in pits. The next process is to stretch the hides so as to open the pores and make the material capable of absorbing the tannin. They are then placed in a solution containing the tanning substance to be used, which is made stronger and stronger as time goes on. After remaining some weeks thus steeped, the hides are carefully drained and dried. The drying process is one that needs the utmost care, as the quality

of the leather depends so much upon it. The finishing touches are now supplied by very efficient machinery, especially graining and smoothing.

Of the various special kinds of leather, Morocco leather is the name applied to the skins of goats tanned with sumach. Roan leather is prepared from sheep skins treated in the same way as Morocco leather. Russia leather is smooth finished leather, impregnated with the oil of birch bark, from which it derives its peculiar odour. Chamois leather, originally made from the skin of the chamois, is a kind of soft leather prepared from sheep skins by treatment with oil alone. The skin is not tanned at all.

The uses to which leather is put are very numerous—boots, shoes, gloves, saddlery, etc. The manufacture of leather and leather goods is a most important British industry, and the value of the unwrought leather imported, and of the finished leather goods exported, has grown enormously in recent years. There are one or two public sales of leather in London every month, and there are quarterly leather fairs at Leeds in January, April, July, and October.

Leather cloth is a textile fabric, which somewhat resembles leather, but is a material having unbleached calico for its background, and being coated with bleached oil, dark pigments, and other ingredients so mixed as to be capable of being uniformly spread over the cloth by rollers. It is often known as American cloth, and is used as a covering for chairs, sofas, desks, etc., a thicker kind being employed for covering coaches.

TEST PAPER XXIII

1. What are the chief sources of supply for hides and skins? To what use are they put?
2. Enumerate the chief products which are provided by the ranching industry.
3. State what you know of leather and the leather industry.
4. Write short notes on horns, skins, meat extracts.

CHAPTER IV

WOOL, HAIR, AND BRISTLES

1. Wool. (Fr. *Laine, poil,* Ger. *Wolle,* Sp. *Lana.*)

This is the hairy covering of certain animals, used for the manufacture of various fabrics. Next to cotton, it is the most important of all fibres. The wool of the alpaca, the angora goat, the camel, and the mohair goat are largely used for the production of woollen goods, but the chief supplies of the substance are derived from the sheep.

Wool is classified in several ways, but there is one distinction invariably established between long and short, the former being used for the manufacture of worsteds and the latter for woollen cloths. After the fleeces are shorn from the sheep, they are scoured and dried. The dried wool is then oiled. If it is long it is combed, and if short carded.

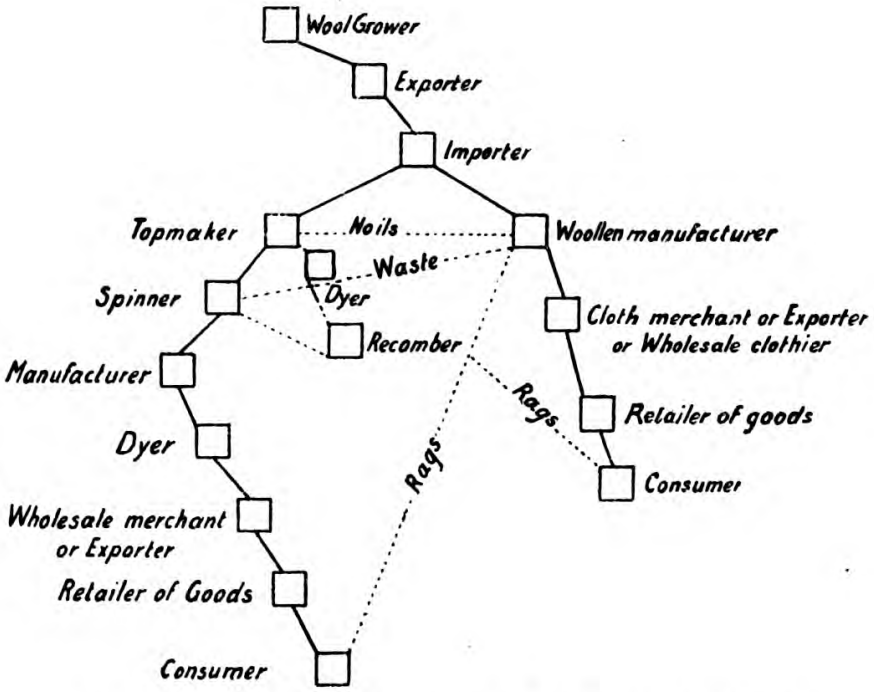
There are many varieties of wool, and owing to the differences in their nature and dimensions the fibres cannot all be treated on the same type of machinery. Long thick fibres can only be spun into thick yarns, but best grown Australian merinos will produce a thread so fine that there are no less than 50 miles of it in a single pound.

With fibres and threads so different from one another, it is no wonder that fabrics made from wool differ more widely than those made from any other class of fibre. Carpets, blankets, Meltons, serges, gaberdines, and the finest Cashmeres and mohairs are all made from fibres grown on different types of sheep, and a knowledge of the properties that each type possesses is essential to success in the management of any business making worsted or woollen goods.

A wool buyer must know by sight and touch alone how fine a yarn any given bale of wool will spin. That is to say, he must be able to estimate whether the fibres which make up the bale are a $\frac{1}{1200}$ or a $\frac{1}{1100}$ of an inch in average diameter. It sounds an impossible task, but it is nevertheless done every day by dozens

of men during a London sale. It is done until use becomes second nature, and long practice gives a sixth sense which appears to be based more on instinct than on knowledge.

A wool buyer must not only be able to estimate the quality or size of the fibre very accurately whilst it is still coated with the grease of the fleece, but he must be able to judge exactly how much clean wool a dirty fleece contains. He must buy the dirty wool and buy it at a figure that will give him clean wool within a fifth of a penny of the market value.



COURSE FOLLOWED BY WOOL IN ITS MANUFACTURE

The total world supply of raw wool is estimated at more than 2,900 million lbs. Of this total, Australasia produces 820 million lbs., Europe 820 million lbs., South America 500 million lb., and North America 337 million lbs., nearly the whole of which is the clip of the United States. The United Kingdom produces only about 180 million lb. of wool each season, but, of course, has at its back the huge wool production of Australasia. The chief sources from which British imports are derived are shown in the table on page 133.

BRITISH IMPORTS OF RAW WOOL.

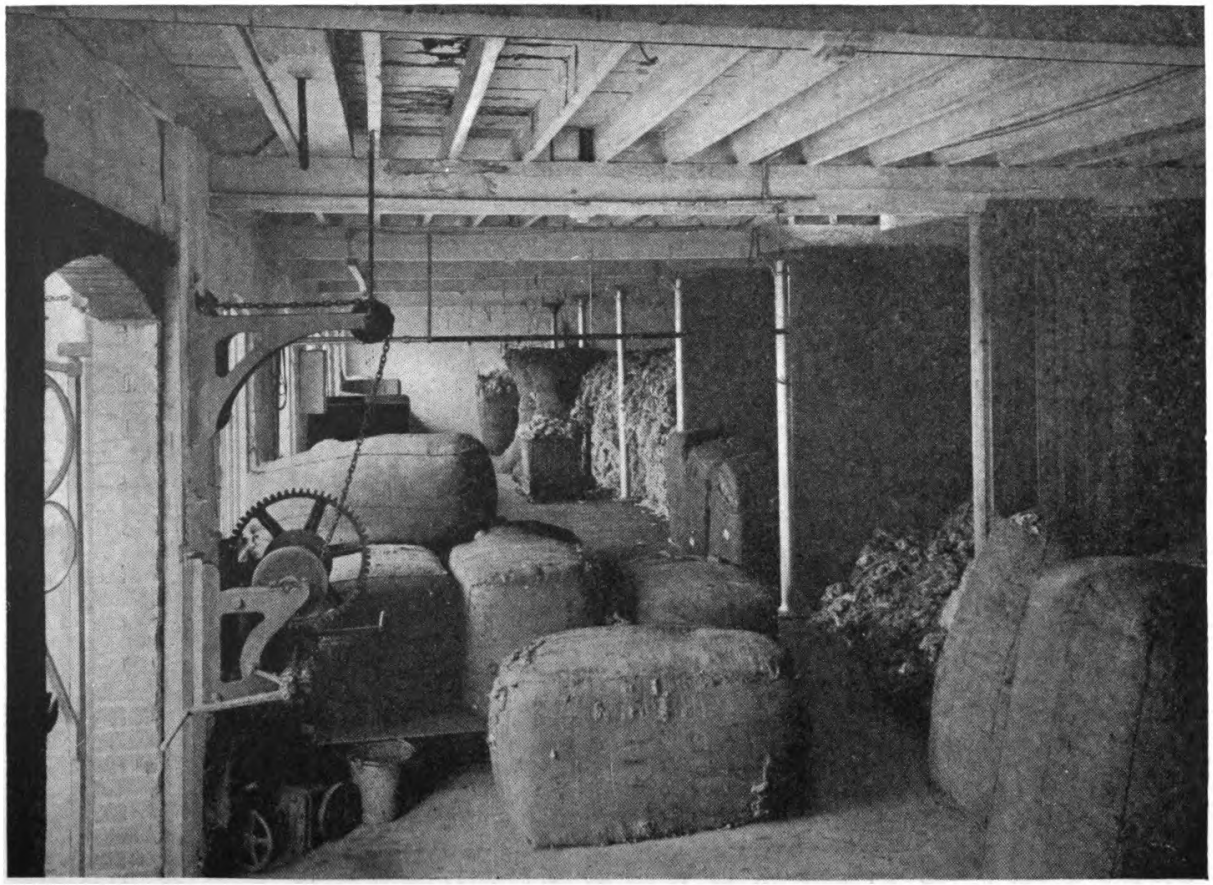
(In Million Lbs.)

	1907	1908	1909	1910	1911
Australia	144	111	105	137	158
New Zealand . . .	134	137	132	153	140
Cape	27	23	32	25	28
India	32	18	28	27	31
Argentine	36	38	36	29	48
Natal	6	9	15	11	22
Chili	13	15	12	17	10

The consumption of wool in the United States is higher than that of any other country. In the year 1909-10 there was retained for consumption nearly 588 million lbs. of wool, of which nearly 264 million lbs. were imported, the balance being provided by the home production of 328 million lbs. Against these figures, the quantity used for manufacturing purposes in the United Kingdom was about 490 million lbs., in France 460 million lbs., and in Germany 380 million lb. The United States could, however, consume a still larger quantity of raw wool, as she is still a large importer of woollen fabrics. Another important buyer of Colonial wool is Germany. The home clip in Germany is diminishing, and the demands of the industry are on the up grade. Germany is not only a large buyer of Colonial wool, but an important customer of Great Britain for tops and yarns.

In the early days, the producing, manufacturing, and consuming centres of the wool industry were largely one and the same; the farmer rearing the sheep, his wife and daughters spinning and weaving the wool, and his dependents being clothed with the home product. The coming of the Industrial Revolution changed all this, and, as the wool growing industry and the machine making industry—dependent upon coal and iron—were fortuitously situated in the West Riding of Yorkshire, there was a gradual concentration of the industry around Bradford, Leeds, and Huddersfield.

Marketing.—In comparison with the complexities of the cotton market, with its varied methods of dealing with the raw material, the sales of wool are carried out by simple and direct methods. There are no highly organized exchanges such as those



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WOOL AT THE MILL

associated with cotton, and practically all dealings in wool are in the nature of spot sales from sample.

At one time London was the main wool market of the world, and, while of late years there has been a tendency to sell Australian wool to a large extent in Australia, the London wool sales maintain a prominent position in the industry, a quantity approaching a million bales (*i.e.*, 300 million lbs.) being disposed of by the small circle of firms, eleven in all, which constitute the organization known as the London Selling Wool Brokers.

The London auction sales are of an international character, being attended by buyers from the home trade, Belgium, Germany, Russia, Austria, the United States, and, indeed, from all countries where raw wool is required. The sales in Antwerp consist mainly of River Plate wools, and there is usually a sale in Bremen once a year for Australian wools which have been bought in the Colony for re-sale in that city. There is also a growing practice of selling Australian wools in Melbourne, Sydney, Brisbane, Adelaide, Geelong, and other centres, but the London wool sales, in spite of their tendency to diminish in importance, still furnish the standard wool prices all over the world.

2. Mohair. (Fr. *Poil de chèvre,* Ger. *Mohairzeug, Haartuch,* Sp. *Tamiz, pelo de cabra.*)

This is the commercial name for the long, soft, curly hair of the Angora and other Eastern goats, animals once peculiar to Asia Minor, but now acclimatized in Australia, South Africa, and North America. Mohair is white in colour and silky in lustre. For more than three centuries it has been imported into Great Britain from Turkey, and was one of the regular articles of the commerce of the old Levant Company. Of recent years the imports have ranged between 25 and 30 million lbs., the larger portion coming from British South Africa, where the goats were introduced about the middle of the nineteenth century. Angoras now number over $3\frac{1}{2}$ millions in the Cape Province. At about the same time Angora goats were taken to the United States, and some $1\frac{3}{4}$ millions of them are found in New Mexico, Arizona, Texas, California, and Oregon. Turkish hair, however, is still the most highly prized variety.

The natural lustre of mohair is zealously preserved in the course

of manufacturing operations at Bradford and other towns of the West Riding of Yorkshire, where its utilization has been carried to the highest pitch of efficiency. The finest qualities of mohair are used for dress goods, the less fine for linings, and the coarse for plushes, braids, skirt edgings and astrakhans. Cloaks and dresses of mohair have peculiar virtues as repellents of dust—a feature which befits them especially for use in connection with motor cars.

Mohair is persistently confused in the public mind with alpaca, although in a state of nature the distinction between the two is obvious enough. Mohair is of a white or yellowish colour, capable of being dyed to the most delicate of shades. In Alpaca the difficulty is to find any white at all in the melange of brown, grey, and black hairs, and without the presence of a due proportion of white, alpaca cannot be dyed even to a satisfactory full shade of black.

Alpaca is the produce of the South American llama, which is kept in captivity on the Andean slopes, and it is shipped principally from Peru.

Alpaca is spun and manufactured largely by the same firms as treat mohair, but the consumption is only one-fifth or one-sixth of the quantity. Its largest employment is in the black lining cloths, in which it is used in conjunction with a cotton warp. Some 16 or 17 million lbs. of mohair and alpaca yarn are regularly exported from this country, principally to Germany.

3. Camel-hair. (Fr. *Poil de chameau*, Ger. *Kamelhaar*, Sp. *Pelo de camello.*)

Camel-hair has a quantitative importance greater than that of alpaca, although by comparison the material is little known. Excellent knitted fabrics are made largely from camel-hair, but are not called by the name of the material from which they are manufactured. Again, there are goods on the market described as camel-hair although there is none of the authentic fibre in their composition. The great Asian desert provides substantially the whole supply of the British manufacturing industry, and the purchases are drawn in approximately equal quantity from the extremes of that area—Russia and China. Climatic influences make the hair of the North African, Persian, and Indian beasts weak and scanty by comparison with that from the North, and so it happens that hair from some of the countries most associated

with the camel in the public mind is of quite inferior textile importance.

Camel-hair is used in making knitted garments, also in overcoatings, blankets, and rugs.

4. Cow-hair. (Fr. *Poil de vache*, Ger. *Kuhhaar*, Sp. *Pelo de vaca.*)

All other supplies of hair are of minor importance. Cow-hair is of material consideration to manufacturers of cheap plushes suitable for draught curtains, mantel borders, or fur for toy animals, and it is used in some cheap carpets and rough blankets made in the heavy woollen district of Yorkshire.

5. Bristles. (Fr. *Soies*, Ger. *Schweinsborsten*, Sp. *Cerdas, Setas.*)

The stiff hairs of various mammals, especially those of the wild boar and the hog. Bristles are imported in enormous quantities into England for the purpose of brush-making, and they are also used by shoe-makers and saddlers. France, Germany, Holland, Belgium, and China do a large trade in this commodity, but the best and most valuable come from Russia in Europe, and from Siberia. The supplies obtained from the United States are increasing year by year. The value of bristles varies from £8 to £60 per cwt.

6. Human Hair. (Fr. *Cheveux, poils*, Ger. *Haar*, Sp. *Cabello, pelo.*)

Besides the hair of various animals used in the manufacture of implements and for the purposes of stuffing, etc., human hair is an article of commerce of no inconsiderable dimensions. The supplies of Great Britain are obtained chiefly from France, Germany, India, and China. That imported from France is dark in colour, whilst that which comes from Germany is light. It is used for making up into wigs. The hair imported from Asia is of a coarser description and this is worked up into watch guards, brooches, bracelets, etc. It is impossible to obtain anything like an accurate estimate of the trade done in human hair alone.

TEST PAPER XXIV

1. Describe the processes to which wool is subjected before it is shipped to this country.
2. Write an account of the woollen industry of England.
3. In what way does the marketing of wool differ from that of cotton ?
4. State what you know of the woollen manufacturing industry.

CHAPTER V

FUR

FUR is the name given to the short, fine, soft hair of certain animals which grows upon the skin. It is distinguished from ordinary hair, which is a longer and thicker material.

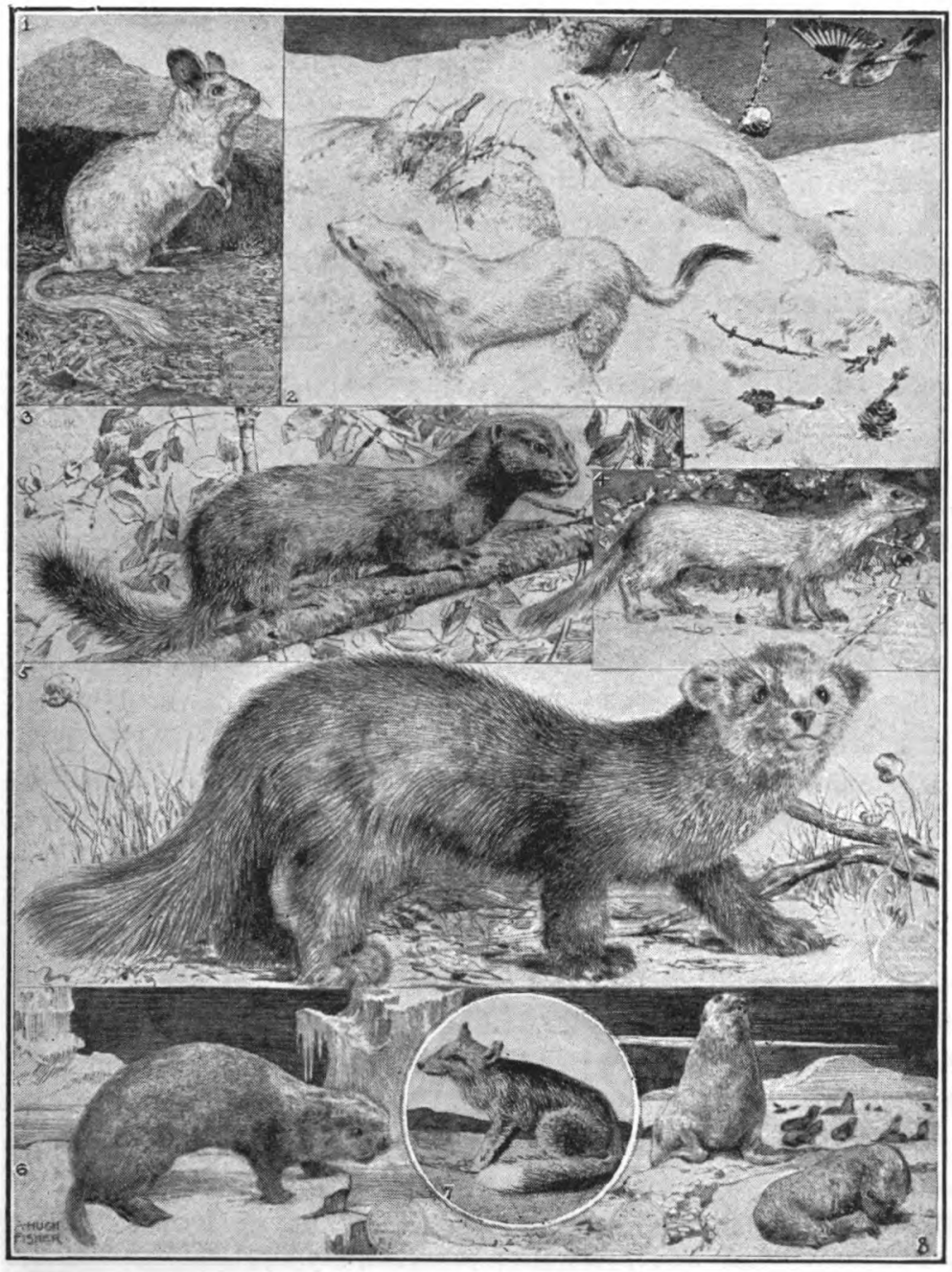
The fur of animals, even more than the feathers of birds, acts as an excellent non-conductor of heat, and is used by mankind as the warmest kind of clothing. The fur covering of animals is usually renewed in the autumn and during the winter it acts as a protector from the cold. Hence it follows that the hunting and trapping of fur-bearing animals takes place chiefly during the winter.

In the manufacture of leather, the extraction of the hair from the skin is one of the first tasks, whereas in the dressing of fur skins the furrier has to pay careful attention to the preservation of the hair covering, as this is the most important part of the commodity, the skin being merely the support of the hair.

Most of the fur-bearing animals belong to the carnivora species, next to which comes the marsupials, then the rodents and various other mammalia, especially sea bears.

The majority and most valued of the fur-bearing animals inhabit the cold, pine forest regions of the northern hemisphere, where large numbers of squirrels, birds, and mice live on the seed, and where the most highly prized of the species of martens live on the the above mentioned seed-eating animals. A further large number of fur-bearing animals, such as the white or polar bear, the ermine, the wolf, the fox, and the lynx, inhabit the polar regions of the Old and New World.

It is only when hunting the larger carnivora of the bear, dog, and cat species that powder and shot is used, whilst the smaller and more valuable fur-bearing animals are caught in traps. The trappers, concerning whom many a book has been written, especially those in the forests of Canada and Siberia, lead a very poor sort of life. It is not the trapper but the dealer who buys the skins from him who derives the largest share of profit from his work.



VALUABLE FUR-BEARING ANIMALS

1. Chinchilla. 2 Ermine. 3. Mink. 4. Canadian Sable.
5. Russian Sable. 6. Sea Otter. 7. Silver Fox. 8. Seal.

This the trapper starts in the summer by making hundreds of traps, which he distributes and supervises in the winter.

The first place amongst fur-bearing animals is occupied by the sable and the ermine. A sable skin is of a brown colour and varies in value with the colour, thickness, length, and brilliancy of the fur.

The ermine is much smaller than the sable, being about the size of a weasel. Its coat is snowy white, like that of the Alpine hare, except for a small black tip on the tail. Furriers experience no difficulty in preparing rabbit skins in such a manner that, to the superficial observer, they resemble ermine skins. The sable was the cause of the opening up and conquest of Siberia, and this animal has paid a large portion of the cost with its skin. The great demand for sable skins has led to a great reduction in the number of sables. A considerable extension of the hunting area has led to the annexation by Russia of the Amur region and the province of Manchuria. In 1858, the first year of Russian occupation, the former region supplied no fewer than 1,500 sable skins, whilst magnificent tiger skins were obtained from the latter area.

No reliable statistics exist regarding the yield of the hunt for fur-bearing animals in Siberia. The estimates fluctuate between an annual yield of from 2 to 3 million roubles. No doubt the larger portion of this amount is due to the enormous production of grey squirrel skins and other cheap furs. A considerable number of Siberian fur skins reach the hands of the Chinese by way of Kiachta and other frontier towns. Another portion of the yield is sold at the fair of Irbit, in the district of Perm, which is held during February and March. Finally, the great fair of Nichni-Novgorod plays an important part in the sale of Russian furs. To this fair are brought for sale the Persian lambs under the name of Astrakhan. These are the black or white skins of newly-born lambs of the broad-tailed sheep, the wool being very shiny and curly. The value of a skin is about 30s., and the value of the turnover of Nichni-Novgorod was estimated at 200 to 300 thousand pounds sterling previous to the Great European War.

The beginnings of the much greater North American fur trade are connected with the settlement of Canada by the French and the foundation of the town of Quebec by Samuel de Champlain in 1608. The colonists settled along the coasts of the St. Lawrence river. Those who preferred to roam the forests to working in the

fields, became hunters and trappers, although they likewise followed the course of the river and its tributaries.

TABLE OF THE CHIEF FUR-BEARING ANIMALS WHICH ENTER INTO COMMERCE.

Area of Production.	*Popular Name.*	*Scientific Description.*
RUSSIAN SIBERIA	1. Sable	Mustela zibellina
	2. Ermine	Mustela erminea
	3. Tree Marten	Mustela martes
	4. Beech or Stone Marten	Mustela foina
	5. Polecat	Putorius foetidus
	6. Glutton	Gulo borealis
	7. Common otter	Lutra vulgaris
	8. Sea Otter	Lutra marina
	9. Arctic Fox	Canis lagopus
	10. Beaver	Castor fiber
	11. Ursine seal	Otaria ursina
	12. Squirrel	Sciurus vulgaris Glires
NORTH AMERICA (Including Canada and the United States)	1. Marten	Mustela canadensis
	2. Ermine	Mustela erminea
	3. Mink	Mustela lutreola
	4. Skunk	Mephitis varians
	5. Otter	Lutra canadensis
	6. Sea otter	Euhydra marina
	7. Racoon	Procyon lotor
	8. Grey squirrel	Sciurus cinereus
	9. Beaver	Castor fiber
	10. Musquash	Fiber Zibethicus
	11. Silver fox	Canis argentatus
	12. Arctic fox	Canis lagopus

From this beginning, the French fur trade developed, but received a mighty competitor half a century later in the shape of the English, who formed the Hudson Bay Company in 1669. Its spiritual founder was Prince Ruprecht, of the Palatinate, a nephew of King Charles II of England, who started the enterprise under the title of "The Governor and Company of Adventurers of England trading into Hudson's Bay." The Company, consisting of seventeen persons, with Prince Ruprecht as the first Governor, received its charter in 1670. The area covered by this charter comprised the whole of the present British North America, with the exception of the French colony of Canada. The Company has played an important part, not only in the fur trade, but also in the history of the exploration of its immense territory.

During the first fifteen years the yield of the fur trade was very satisfactory, the Company being enriched to a high degree. For the purpose of exploitation, the whole area was divided into four departments—

1. The Northern Department, with Fort York, at the point where the Nelson river flows into the Hudson Bay, as the principal depot, with thirty-four other forts under it.

2. The Southern Department, with twenty-eight forts, at the head of which was Mous factory at the southern end of the Hudson's Bay.

3. The Montreal area, with Lachine, on the St. Lawrence river, near the present town of Montreal, as the principal factory.

4. The Colombia Department, where Fort Vancouver, to the west of the Rocky Mountains, was the principal factory.

The forts were fortified trading factories, each of which possessed two warehouses. In one of them the official in charge received the furs which the Indians or trappers had collected. After being valued by the official, the trapper received in exchange a number of tablets corresponding to their value. These were called castors, after the beaver skin, which was regarded as the standard of value, being equal to one pound sterling. With these castors, the trapper went to the European goods depot, where he exchanged them for his various requirements. As long as beaver skins were used in the manufacture of tall hats, they continued to maintain their high prices. Thus, for instance, in 1800 Quebec exported 120,000 beaver skins to the value of as many pounds. Later on, however, when the much cheaper silk began to take the place of beaver skins in the manufacture of hats, they fell considerably in price, and were only used in the manufacture of collars and cuffs, and for the lining of coats. In any case, at the end of the nineteenth century the number of beaver skins exported had risen to 200,000 per annum.

A near relative of the beaver is the beaver rat, or " nutria," as it is called in the fur trade, which lives in the rivers and swamps of South America. It is the size of our European fish otter, and the principal exporter of this skin is the province of Entre Rios, in the Argentine.

The musk rat, or musquash, next to the squirrel, is undoubtedly

the most numerous fur-bearing animal of America. According to the *Encyclopaedia Britannica*, the annual production of these skins is estimated at about 3 million, although this figure may be greatly exaggerated. Anyhow, at the weekly auctions held during the winter in London, there are sometimes from 80 to 150 thousand skins offered for sale. The dark brown backs of these animals are used for the making of fur coats, whilst the much inferior yellowish " bellies " are used as linings.

The racoon is likewise very frequently met with in America. Its long brown fur is used for the making of travelling rugs.

Lastly, mention should be made of the delicate fur derived from Argentina, Peru, and Chili which is known as chinchilla; the silver fox, the Arctic fox, the wolf, and other carnivora pursue the Alpine hare to the far north. Amongst specially Canadian fur-bearing animals, the amphibious beaver and musk rats are the first as regards numbers and usefulness.

In more recent times, Australia has participated in the production of furs for the European market. The most highly esteemed of its fur skins are the Wallaby—a relative of the kangaroo; and, to a still greater extent, the skins of the Australian opossum, which come into the market in very large numbers. They are of a greyish-brown colour with dark stripes along the back.

Among the lowest valued furs exported from Australia and New Zealand to England are those of the rabbit.

Many of the well-to-do settlers in Australia were anxious to introduce rabbit shooting as a sport into their country and thus, in 1862, they imported the rabbit, arranging for this import to cease in 1871. The climatic conditions of the country favoured the propagation of these animals to such an extent that they increased beyond all expectations, so that ultimately they undermined large tracts of soil and inflicted great injury upon the stock-raising industry.

Thus the sport of rabbit hunting was converted into a rabbit plague, against which barbed wire and other means of defence proved unavailing. Hitherto the reduction of the rabbits has not met with very great success, as is proved by the statistics of exports. These show that the annual value of the exports of rabbits and rabbit skins from Australia amounts to about half a million pounds sterling, whilst in the case of New Zealand the exports amount to about 5½ million skins of the value of £52,000.

The principal market for raw fur skins is London, where they are offered for sale during the winter at weekly auctions. The Siberian furs tend to go in the opposite direction; that is, into the hands of the rich Chinese. Most of them reach the February fair at Irbit and in the summer that of Nichni-Novgorod. The principal centre for the dressing of fur skins is Leipzic, which, in this particular trade, plays as important a *rôle* as Paris in connection with ornamental feathers.

TEST PAPER XXV

1. Say what you know of the history of the fur trade.
2. What are the different kinds of furs imported into this country ? Whence are the furs obtained, and what are their comparative values ?

CHAPTER VI

DAIRY PRODUCE

1. Milk. (Fr. *Lait*, Ger. *Milch*, Sp. *Leche*.)

In various parts of the world different animals have been used to provide milk for the use of man; in fact, it seems probable that every domestic animal except those which are carnivorous has been put to this service. Besides the cow, from which our chief supplies are obtained, the following animals are used in their respective countries. The goat in most mountainous regions, to some extent in England, and in parts of Switzerland; the sheep in several pastoral countries; the reindeer in Lapland; the camel by the Bedouins and others who use this animal; the sow in China; the mare by many Central Asian tribes; the ass commonly in various countries.

2. Butter. (Fr. *Beurre*, Ger. *Butter*, Sp. *Manteca*.)

The solid fat which is obtained from the milk of all mammals. For commercial purposes, however, the only butter which is met with is that made from the milk of cows. The fat is contained in very small globules in new milk, enclosed in a thin sac or membrane, and these globules rise to the surface as cream. Generally, the cream is removed and subjected to a prolonged agitation in a churn. This agitation ruptures the membranes and the particles of fat coalesce. Sometimes a little hot water is added to the cream, or the churn is placed in a hot-water bath. The fat is then kneaded and pressed, and butter is the result. Butter is also prepared from new milk itself before the cream has been separated. The chief principles of butter are stearine, margarine, and olein, together with small portions of casein, and butyric and caproic acids, the last mentioned giving the peculiar aroma and taste. The colour is either white or yellow, depending upon the quality of the milk and cream used, which quality varies with the feeding of the cows and the districts in which the butter is prepared. Sometimes, and especially for inferior kinds of butter, annatto is employed as a colouring matter. Owing to the fermentation of the nitrogenous casein, butter quickly becomes rancid unless it is salted.

The salting is best done by using a mixture of nitre, sugar, and salt. Adulteration is common, lard, flour, or potato starch and other substances being mixed with it. To increase its weight, water is often added.

There is an extensive trade carried on in this article. England is, in proportion of its population, the greatest consumer of butter in the world, and, in addition to that which is home-made, thousands of tons are annually imported from France, Denmark, Holland, and the United States. Ireland not only supplies the wants of its own population but also exports a considerable quantity.

Butterine is a mixture of animal fats with a certain amount of butter added. When well made, it is not easy to distinguish butterine from good butter, except by chemical analysis. It is sold as margarine. To prevent the frequent imposition practised by selling butterine as butter, an Act of Parliament was passed in 1887 regulating the sale of this article. It is chiefly imported from Holland.

Buttermilk is the residue after the cream or new milk has been churned in the preparation of butter. Although the main portion of the fatty substances in the milk has been removed, the liquid which remains is a very nutritious, healthy, and digestive beverage. It is largely drunk in the country districts of England, but more so in Scotland and Ireland. It possesses a slightly acid taste, which has been developed in the churning of the cream.

3. Cheese. (Fr. *Fromage*, Ger. *Käse*, Sp. *Queso.*)

The food substance made from compressed and partially dried curd of milk. There are many kinds of cheeses, and the process of manufacture varies in different localities, but the main principle is the same. The milk is first warmed and fermentation set up by the addition of a small quantity of rennet. This causes a separation in the form of curd of the casein and the fatty matter in the milk. The curd is then broken up and drained from the whey or watery part of the milk. The remaining portion of the whey is extracted by means of a press, and the residue is again broken up, salted, and turned into the required shape. It is afterwards dried in a well-ventilated room. For the purposes of colouring, annatto is generally used. The richest cheeses, Cheddar, Cheshire, Gloucester, and Somerset, are made from new milk, and in the manufacture of Stilton cream is even added to the new milk. From being an

industry connected with the dairy, cheese-making has become a trade which requires huge factories and many hands. England imports hundreds of tons annually, mainly from America. Gruyère is made in the Canton of Fribourg, Switzerland. Other highly prized cheeses are Camembert, Brie, Lenbury, and Gorgonzola.

4. Cream. (Fr. *Crême*, Ger. *Rahm*, Sp. *Crema, nata.*)

The fat of milk which exists in minute globules in new milk. Being lighter than the milk itself, the cream rises to the surface, and overspreads the whole. It is generally of a yellowish colour. Machines, called cream separators, have been devised for dividing the cream from the milk with greater speed than can be done when the operation is left to nature, and also for extracting the whole instead of a part. Cream is the source of butter, and is a most important article of commerce. A considerable trade is carried on in the manufacture of various kinds of creams, the principal of which are—

1. DEVONSHIRE CREAM.—This is prepared by heating new milk in wide pans after it has been allowed to stand for a day. Care must be taken that the milk does not boil. After standing again, the cream is skimmed off and sugar added.

2. WHIPPED CREAM.—This is made by beating up new milk or cream with the white of eggs.

3. VANILLA CREAM.—When whipped cream is sugared and flavoured, it is called vanilla cream.

4. CREAM CHEESE.—Rich cream is first tied up in a clean wet cloth, kept in a cool place for several days, then transferred to a finer cloth, and afterwards placed in a mould.

5. Eggs. (Fr. *Oeufs*, Ger. *Eier*, Sp. *Huevos.*)

The ova of birds. The eggs of fowls, which comprise about 80 per cent. of those used, enter largely into commerce and are imported both as an article of food and for use in manufactures. Great Britain imports them from most European countries and from some of her Colonies. The dried white of eggs, or egg albumen, is a substance largely used in calico printing and in photography.

6. Honey. (Fr. *Miel*, Ger. *Honig*, Sp. *Miel.*)

The thick saccharine liquid substance secreted by bees, and deposited by them in the combs of their hives. The two principal

kinds are yellow and white, though there are great differences in the taste owing to the locality in which the bees are reared, the age of the hives, and other circumstances. Honey consists mainly of glucose, cane-sugar, gummy matter, and essential odorous oils, together with minute quantities of various mineral matters. Little attention is paid to the rearing of bees in England, though it is not an inconsiderable industry in Ireland, and the honey of Scotland is celebrated. The most celebrated Continental honey comes from Narbonne and Chamounix, and the greatest quantity is imported from America, especially from California. The honey is extracted by straining the comb in a very gentle heat. Honey is used in the preparation of the fermented liquor, mead.

TEST PAPER XXVI

1. Enumerate the principal articles of commerce which are embraced by the term " dairy produce."
2. Write short notes on milk, butter and eggs.
3. Say what you know of the preparation of cheese as a commodity of commerce.
4. State, and account for the location of, the chief dairy farming centres of England.

CHAPTER VII

POULTRY

THE term "poultry" is applied to different kinds of large birds in a state of domestication, such as the chicken, or barn-door fowl, ducks, turkeys, guinea fowl, pigeons, peacock and pea-hen, and the ostrich. The breeding of poultry is carried on for three main purposes, namely, the production of eggs, meat, and feathers. In the provision of food for the people, this branch of production has a value in the import and export statistics of many countries far in excess of that which is indicated by the statistical figures.

1. Common Fowl. (Fr. *Volaille ordinaire*, Ger. *Gewohnliches Geflugel.*)

This is the most widely distributed and probably the oldest domesticated animal. The domestication of this useful bird seems to have taken place in the earliest times, and Persia is generally supposed to have been the country of its origin. The best known varieties are the Game Fowl, the Dunghill Fowl, the Dorking Fowl, the Brahmaputra, the Spanish Fowl, and the Bantam.

2. Duck. (Fr. *Canard*, Ger. *Ente*, Sp. *Ãnade.*)

The duck differs in many respects from the fowls already mentioned, being aquatic in its habits. It is marked by a flat bill and webbed feet, characters also possessed by the goose and swan, which, in conjunction with the duck, may be regarded as forming a distinct family of the feathered aquatic tribes.

Ducks are easily kept, particularly near ponds or streams of water. Almost every farmer finds it profitable to keep a few ducks, and, where there is an extensive grass or waste run, a large number may be kept with advantage. Their food costs very little, and they lay large good eggs, if not very many of them.

3. Turkey. (Fr. *Dindon*, Ger. *Truthenne*, Sp. *Pavo.*)

The turkey is a native of the woods of North America, and is one of the most valuable fowls which have been naturalized in England. The egg of the turkey forms a most delicious food, more delicate in flavour than that of the common hen. The varieties

of turkey most common in England are the Norfolk and the Cambridge.

4. Guinea-fowl. (Fr. *Pintade,* Ger. *Perlhuhn,* Sp. *Gallina de Guinea.*)

The guinea-fowl is about the size of the common hen, and, as its name implies, is a native of Africa. It is valued because of its flesh and beautiful appearance, although it is usually kept more from curiosity than for profit.

5. Ostrich Feathers. (Fr. *Plumes d'autruche,* Ger. *Straussfedern,* Sp. *Plumas de avestruz.*)

The long plumes of the ostrich, which have been valued for centuries for ornamental purposes. They are obtained from the wing and the tail, each wing giving about twenty-five good feathers, and the tail about a dozen. They are divided into many classes in commerce, according to their colour and length, and the prices vary to a considerable extent. The principal supplies are obtained from South Africa where the ostrich is domesticated for the sake of the feathers. Efforts have been made, with some success, to extend the farming to Algiers, Egypt, West Africa, Australia, and California. The American ostrich, however, is of a genus totally distinct from the African ostrich.

TEST PAPER XXVII

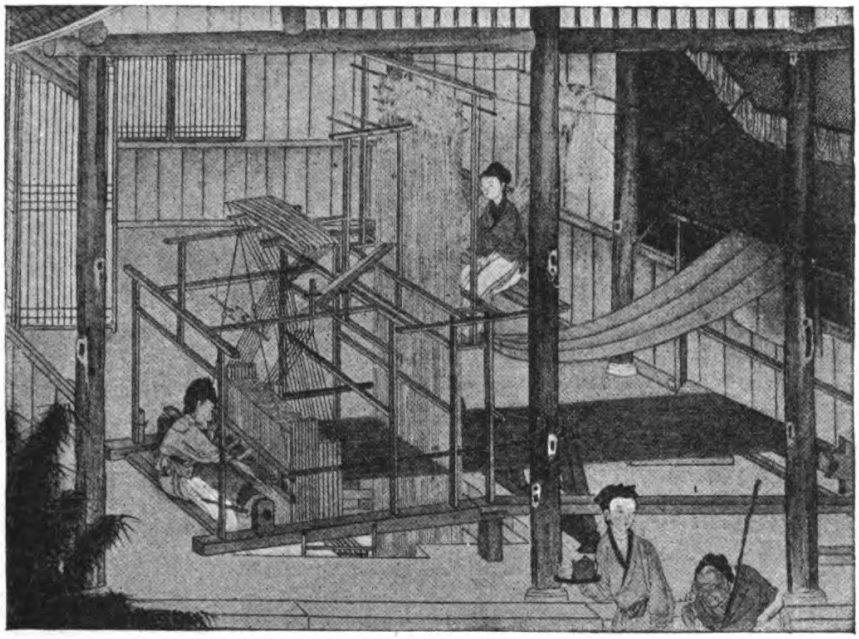
1. Explain the meaning of the term " poultry."
2. Enumerate the chief kinds of poultry which enter into commerce.
3. Write a short account of ostrich feathers under the following headings—
   (*a*) Sources of supply.
   (*b*) Chief uses.

CHAPTER VIII

PRODUCTS FROM THE INSECT WORLD

1. Silk. (Fr. *Soie,* Ger. *Seide,* Sp. *Seda.*)

The fibre on the cocoon of the silk-worm, chiefly the *Bombyx mori.* It is the strongest, most lustrous, and most valuable of all textile fabrics. The climate of England is not favourable to the cultivation of the silk-worm. Consequently, the manufacture of silk and of silk goods is mainly carried on abroad, the principal countries manufacturing in Europe being France, Belgium, and



CHINESE DRAW-LOOM

Holland. Silk goods are imported into this country in various forms, as, broad stuffs, ribbons, laces, etc.

The British silk trade is widely distributed throughout the kingdom, the only definite centres of work being Macclesfield and Leek. Of the 32,036 persons given in the Census of Production Returns for 1908, 30,520 were employed in England and Wales, 994 in Scotland, and 522 in Ireland. Large quantities of twills, satins, and brocades are manufactured annually at Macclesfield

and Leek, and the making-up of scarves, ties, bows, and knitted silk articles has developed very considerably in recent years. Silk laces, nets, and veilings are produced chiefly in the Nottingham lace district. A comparatively small trade still remains in the London district, the chief articles produced being high-class linings and silks for the men's trade.

During the last thirty years there has been a great decline in the consumption of raw silk. Whereas in the period from 1880–82 the net imports averaged nearly 2,400,000 lbs., the average for 1912–14 was less than a million. The principal sources of supply are China and France, the net imports from the former being about 498,000 lbs. and from the latter 166,000 lbs., out of a total net import of 859,000 lbs.

2. Cochineal. (Fr. *Cochinelle*, Ger. *Cochenille*, Sp. *Cochinilla*.)

True cochineal consists of the bodies of the female *Coccus cacti*, an insect found on various species of cactus in Mexico, Spain, the Canary Islands, Algeria, and Java. The insects are collected after they have laid their eggs, and are killed by being subjected to the action of steam, or by the heat of an oven. *Carmine* is the colouring-matter prepared from cochineal by various processes. It owes its beautiful red colour to carminic acid, a red solid, soluble in water and alcohol. Carminic acid when boiled with dilute sulphuric acid, yields a special kind of sugar, and a substance called carmine-red.

3. Lac. (Fr. *Laque*, Ger. *Lack*, Sp. *Laca*.)

This is the product of an insect, *Coccus laccae*, a native of India and the East Indian Islands. The female insect punctures the twigs of various trees and shrubs, and lays her eggs in the milky juice which exudes. This juice hardens into a resinous mass, which encloses the eggs and the dead bodies of the parent insects. The caterpillar, emerging from the egg, eats its way through the surrounding resin. Lac occurs in commerce in three forms—

(*a*) STICK-LAC.—That is, lac in its natural state, adhering to the twigs from which it was formed.

(*b*) SEED-LAC.—That is, lac picked off from the twigs, and deprived by treatment with water of some of its colouring-matter; and

(*c*) SHELLAC.—That is, lac which has been fused and strained

through a cloth, and has thus lost nearly all its colouring-matter, and consists almost entirely of lac-resin. Shellac is used for the manufacture of sealing-wax; dissolved in alcohol, it forms the common spirit-varnish.

TEST PAPER XXVIII

1. Explain as fully as you can the manner in which silk is obtained from the silk worm.

2. Through what processes does silk go from the time of its being obtained from the silk-worm to its being put on the market as a finished article ?

CHAPTER IX

FISHERIES

In the extended use of the term, fishing embraces the obtaining of the most varied forms of animal products from the rivers and seas, such as ordinary fish, shell fish, molluscs, corals, and sponges, whether intended for food or for other purposes. Just as the fauna of the tropical countries presents the greatest variety of species, forms, and colours, so the population of the warm waters, especially of the tropical seas, is rich in variety.

The largest and most remunerative fishing grounds of the ocean are to be found in the higher latitudes of the northern hemisphere, especially between latitude 30° and 60° N. This remark applies not only to both coasts of America but also to the corresponding areas of the Old World. An exception to this rule is the Norwegian coast where the most prolific fishing ground stretches from the southern extremity (lat. 58° N.) far beyond the Polar Circle. This is evidently connected with the Gulf Stream Drift, which increases the temperature of the coast by 6° C., insures freedom from ice, and carries large quantities of the lower forms of animal life as food for the fish.

There are three families of fish which are of importance in consequence of their great numbers and their value as a food.

I.—THE HERRING FISHERY

The herring family gives rise to the most important branch of the fishing industry. It is represented by about 180 varieties, which serve not only as food for man but also for the larger fish of prey and the mammalia of the sea. The best known varieties are the common herring, the pilchard, the sprat, the sardine, whitebait and the anchovy.

The most important British herring fisheries are carried on along the coasts of Scotland, the chief centres for which are Dunbar, Peterhead, Fraserburgh, and Wick. The greater part of the fish taken in Scotland is cured for exportation—a trade requiring a large amount of tonnage and providing employment for large

numbers of people. There is also an important herring fishery at Yarmouth, a large portion of the catch being cured and sent to market as "bloaters." The pilchard is chiefly caught on the coasts of Cornwall; and the sprat is obtained in large quantities in both England and Scotland.

II.—THE WHITE-FISH FISHERIES

This family has about seventy varieties, the principal representatives of which are the common cod, the haddock, whiting, ling, and hake—all remarkable for the excellence of their flesh, which is white and firm, separates readily into flakes, and is agreeable to the taste.

The common cod forms the most important object of fishing in Newfoundland and the Lofoten Islands. This fish often reaches a length of $1\frac{1}{4}$ yds., with a weight of about 90 lbs. Better known still is the smaller haddock, which is much esteemed when fresh, as also when dried and brought to market as the well-known Finnans.

III.—THE SALMON FISHERY

The members of the salmon family, owing to their beautiful shape and markings, and, above all, owing to their highly esteemed flesh, are regarded as a luxury of the table. Their chief habitat is to be found in the colder seas and the clear mountain brooks. Many of them ascend the rivers during the spawning period. This family occurs in the largest numbers in the Northern Pacific Ocean, on the coasts of the Sea of Ohhotsh and the Behring Sea, in the lower courses of the rivers of Yezo, in Saghalien and Kamschatka, as also around the peninsula of Alaska.

In the year 1913, the total value of fish landed in England and Wales amounted to £10,336,000, in Scotland to £3,997,000, and in Ireland to £358,000—a total of approximately $14\frac{1}{2}$ million pounds sterling for the United Kingdom. This is more than double the average catch twenty years ago. Billingsgate Market, in London, is pre-eminently the centre of the British fish trade, but it is not true that the whole of the fish trade passes through Billingsgate, or that the wholesale distribution takes place only from there.

It should be remembered that all fish are more or less migratory,

and such fish as herrings, mackerel, pilchards, and sprats are markedly so. Consequently, the landings of fish at any particular port vary according to the season, and also according to the ground which the ships landing at that port are for the time being frequenting. It may, therefore, happen that a certain kind of fish is scarce, or is not represented on a given day in the market at this or that port, whereas it is abundant (or at least represented) at other ports. Billingsgate, therefore, becomes a central clearing house for London and the Home Counties, and to some extent for the south of England. From this centre fishmongers can secure the various kinds of fish they require, which otherwise they might have to draw from a number of ports.

In dealing with fisheries, reference must also be made to three other important products from the seas, viz., pearl, mother-of-pearl, and coral.

1. Pearl. (Fr. *Perle,* Ger. *Perle,* Sp. *Perla.*)

The substance formed by several shell-bearing molluscs, which are provided with a secretion with which they line their shells. The secretion is laid in thin, semi-transparent films, and gives rise, by reason of the arrangement, to a beautiful iridescence. The pearls of commerce, which consist of rounded secretions of a substance called nacre, are the result of accident. The nucleus of the pearl is a grain of sand or other particle of solid matter which becomes coated over with the nacreous secretion. The principal source from which pearls are obtained is the pearl oyster. The chief fisheries are off Ceylon, but others exist in the Persian Gulf, the West Indies, and Australia. Pearls are of various colours, white, black, and pink, and their value depends upon their size and purity. Excellent imitations are manufactured for necklaces and decorative purposes, the French being very clever in this peculiar industry.

2. Mother-of-Pearl. (Fr. *Nacre de perle,* Ger. *Perlenmutter,* Sp. *Nácar.*)

The brilliant internal layer of certain shells belonging to the oyster family. Various kinds are obtained from the Philippine Islands, the Sandwich Islands, Singapore, and Western Australia. This substance is used for inlaying, and for the manufacture of knife handles, studs, buttons, and other ornamental articles.

3. Coral. (Fr. *Corail,* Ger. *Koralle,* Sp. *Coral.*)

The name applied to the stony skeletons of certain marine animals belonging to the same class as the sea anemone. The red coral, used for making beads, necklaces, etc., is found in the Mediterranean at a considerable depth. It is capable of taking a high polish, is very hard, and the finer qualities command high prices. It is fished for by means of nets.

TEST PAPER XXIX

1. Account for the distribution of the world's chief fishing grounds.
2. Mention three great families of fish which are important in consequence of their great numbers and their value as a food.
3. Write brief notes on pearl, coral and mother-of-pearl.

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