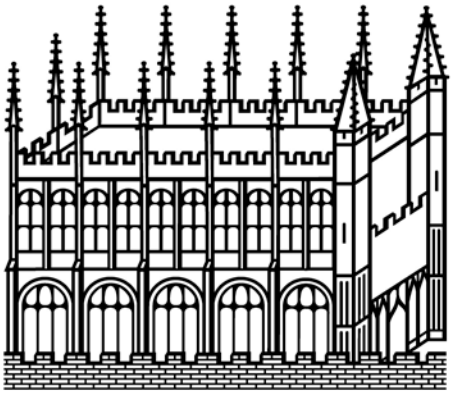


HANDY BOOK OF OBJECT LESSONS.

THE HANDY BOOK

OF

OBJECT LESSONS.

THE HANDY BOOK

OF

OBJECT LESSONS.

FROM

A TEACHER'S NOTE BOOK.

BY J. WALKER.

REVISED BY REV. H. SMITH. H. M. I. OF SCHOOLS FOR WEST CHESHIRE.

THIRD EDITION

LONDON:
JARROLD & SONS, 3, PATERNOSTER BUILDINGS.

PREFACE.

It not unfrequently happens that young teachers, especially in country schools, experience great difficulty in finding suitable materials for Notes of Lessons.

To supply this want has been the object of the compiler of the present manual, the lessons of which have been culled from various sources, and are the result of many years' experience in teaching.

A fourfold classification has been made, which it is hoped will facilitate reference, and enable the teacher to vary his subjects. In addition to this it will be observed that each lesson is divided into two columns, viz., Matter and Method, the former containing the information to be imparted, while the latter is intended, not to be dogmatically adhered to, but to serve as a specimen of the various expedients to which teachers may resort.

March, 1873.

CONTENTS.

Part I.—The Animal Kingdom.

Part II.—The Vegetable Kingdom.

Part III.—The Mineral Kingdom.

Part IV.—Miscellaneous.

Notes of Lessons on Familiar Objects.

PART I.—THE ANIMAL KINGDOM.

THE ELEPHANT.

MATTER.

I. Locality.

Elephants are found in Asia, Africa, Hindostan, and parts of Further India, or India beyond the Ganges ;[1] but they are most frequently met with, in a wild state, in Africa.

II. Description of the Elephant.

(*a*) SIZE. The Elephant is the largest animal we have. It varies in height from 7 to 15 feet.[2]

(*b*) BODY. Very bulky—weighs several tons and is covered with short bristles.

(*c*) HEAD. Very heavy—sometimes weighs 300 lbs.[3]

(*d*) NECK. Very thick and short.[4]

(*e*) TRUNK. Serves both as a nose and also as hands. It consists of a number of elastic rings, and is so made that it combines great strength with the utmost delicacy of touch. By means of it the elephant is enabled to tear off large branches of trees, pick up a pin, untie a knot, or open a door. The trunk is also its chief means of defence.

(*f*) EARS. Pendent[5] and very large.

(*g*) TUSKS. Peculiar to the male. They are generally about 4 feet long and are composed of solid ivory.

(*h*) LEGS. Very thick, like pillars.[6]

III. Habits.

When wild, elephants wander in vast herds. They are very fond of bathing, and are therefore often found in or near the water, where they frequently wallow in the mud[7] and afterwards repose beneath the shade of some forest tree. Their food consists of vegetables, shrubs, and the branches of trees.

METHOD.

There is a very large animal which is generally to be seen in a wild beast show: What is its name? **The Elephant.**

[1] Show these countries on the map.

[2] Compare with objects in or near the school to give the children an idea of the size of an elephant.

[3] Considerably above 2 cwts. (The upper classes might work the sum on the Bk. Bd.)

[4] Why? Shew the result if the elephant had a *long* neck.

[5] What does this word mean? Elicit other animals having pendent ears.

[6] Why? To support the body.

[7] Why? It cools them: the countries in which they are found being very hot.
(Comp.: boys bathing in summer).

When tame, they feed on cakes, fruits, nuts, &c., and are often taught to perform a variety of tricks, such as ringing a bell, untying a knot, &c.

Elephants are docile, but they are also very revengeful of injuries (illus. : the tailor of Surat.)

IV. How Captured.

A herd is surrounded by hunters, who drive the elephants into an enclosure. Here they are bound to trees, beaten often by tame elephants, called "decoys,"[8] kept without food for a week or a fortnight, after which they generally become docile.

[8] Why? Because they "decoy" or entrap the wild ones.

V. Uses.

(1) As a beast of burden[9] or draught, especially in time of war, when they are made to pull heavy cannon along the rough roads of their native country.

(2) To assist in launching vessels. (Give the story of one which was reproached by its master as a "lazy beast.")

(3) The ivory of their tusks is made into a variety of useful and ornamental articles.

[9] What are beasts of burden? Elicit names of such animals in this country.

THE LION.

MATTER.

I. Where found.

Lions are found in the hottest parts of India, in the jungles[1] near rivers, and in the plains of Africa.

II. Description of the Lion.

(*a*) HEIGHT. About 4 ft.[2]

(*b*) LENGTH. About $5\frac{1}{2}$ feet, but sometimes upwards of 8 feet.[2]

(*c*) TAIL. About $3\frac{1}{2}$ feet long.[2]

(*d*) MANE. Peculiar to the male. It grows longer and thicker as the animal gets older.

(*e*) EYES. Round and very large. When the lion is irritated its eyes appear like balls of fire.

(*f*) FEET. Covered on the bottom with a soft velvety pad.[3] Its claws are encased in sheaths similar to those of a cat, so that it can protrude or retract[4] them at will.

METHOD.

To-day we will talk about another animal often seen in shows. It has a very large mane. What is its name? **The Lion.**

[1] What are jungles? Shew why lions lurk in these parts.

[2] Compare these with some object in or near the school-room. Why?

[3] Why? So that they may approach their prey noiselessly, and thus make sure of catching it.

[4] Explain these words (in an upper class give their derivation).

III. Habits.

The lion is a very ferocious animal. It seldom attacks any kind of prey openly, but springs upon it from its lair, or hiding place. Deer and antelopes[5] are its favourite food. The strength of the lion is great: it can carry off a heifer as easily as a cat can a mouse.

[5] What are antelopes?

IV. Uses.

(1) To hunt. This is done chiefly in Africa.[6] It is a very dangerous sport, horses and their riders sometimes falling victims to their madness.

(2) Their skins are often used as carriage rugs.

[6] Show how the Hottentots catch them; viz., by ensnaring them at the edge of a precipice.

THE TIGER.

MATTER.

I. Where found.

Tigers are found only in Asia. The most noted are those of Bengal[1] (a province in the N. of India), called, from the country in which they are found, "Bengal Tigers."

II. Description of the Tiger.

(*a*) GENERAL APPEARANCE. The ancients had a saying, that, as the peacock is the most beautiful of birds, so the tiger is the most beautiful animal. Tigers belong to the cat kind, and so much resemble it that, if we could imagine a cat magnified to the dimensions of a tiger, we should have a tolerably clear idea of the latter.

(*b*) HEAD. Not so long as the lion's, but rounder.

(*c*) EARS. Small and erect[2] and rather rounded at the point.

(*d*) HEIGHT. From 3 to 4 feet according to the species.

(*e*) COLOUR. Bright reddish yellow, with black stripes round the body; the underneath parts pure white.

III. Habits.

Tigers very much resemble lions in their habits, but they are much more ferocious. They

METHOD.

There is a wild beast, the body of which is beautifully striped, what is its name? **The Tiger.**

[1] Shew on the map.

[2] What does "erect" mean? Elicit the names of any animals which have erect ears.

prowl about villages, and frequently carry off buffaloes, devouring them at their leisure in the recesses of some thick forest.

When tamed they become very fond of their keepers.

IV. Uses.

(1) To hunt. A very dangerous pastime; often attended by serious consequences and sometimes loss of life. Tigers often overcome elephants, the animals upon which the huntsmen ride.

(2) Skin. Very valuable. Used as hearth-rugs, or rugs for travelling.

THE BEAR.

MATTER.

We will say a few words to-day about a very lazy animal—one which you may have seen in the streets, led by a man with a strong chain in his hand. What animal do I mean? **The Bear.**

I. Where found.

Bears are found in various parts according to the species to which they belong: *e.g.*, the brown bear inhabits the forests of Germany, Russia, and the borders of France. The white bear[1] is found in the Arctic regions, and the black bear in Asia.

[1] Why white? So that it may not be seen and caught so easily. Draw the attention of the class to the fact that the colour of the Polar Bear is often the means of saving its life, and shew how.

II. Description of the Bear.

(*a*) SIZE. Varies according to the kind. The brown bear is sometimes 5 or 6 feet long; the white bear 12 or even 13 feet.

(*b*) TEETH. Like those of man. Their cheek teeth are not pointed like those of other beasts of prey.

(*c*) TOES. Five, as we have.

(*d*) CLAWS. Long and strong to assist them in climbing.[2]

(*e*) FUR. Very thick to keep them warm.

[2] Climbing what? Trees. What for? Honey, of which they are particularly fond.

III. Habits.

The bear is a solitary animal: it lives by itself nearly the whole year, sleeping a great part of it in some hollow tree or cavern. In spring it comes forth lean[3] and hungry, when it is dangerous to meet it. At such times it devours anything it can get. It overcomes its prey by squeezing it to death between its fore paws.

[3] Why lean? Because it has fasted the whole winter.

Brown and black bears feed on honey, flesh, and vegetables; white bears on fish.

IV. Uses.

Bears are especially useful to the inhabitants of cold countries.

(1) Skin. Made into coats, caps, and gloves, with which the inhabitants of the arctic regions clothe themselves.

(2) Flesh. Eaten, and said to resemble pork.

(3) Hide.[4] Makes very strong leather.

(4) Fat. When melted down is prized for various purposes, one of which is as grease for the hair.[5]

(5) Intestines. Used as window panes, and are said to answer well when properly prepared; but they are only semi-transparent.[6]

REMARKS. The common way of capturing bears, is, to throw brandy upon honey. Having eaten heartily they become intoxicated, and are then easily overcome. Another method is, to set fire to the tree in which they are lying. The smoke and heat drive them out: they are then shot, after which their cubs[7] are caught in a noose,[8] and either killed for their hams, or preserved.

Bears are taught to dance by making them walk on hot plates of iron.[9]

[4] What is the hide? The skin after the hair is taken off.

[5] Hence "Bears' Grease."

[6] i.e., it cannot be seen through clearly (semi=half).

[7] What are cubs? (Compare the young of the lion.)

[8] What is a noose? Sketch one.

[9] Show how cruel is such a practice.

THE WOLF.

MATTER.

I. Where found.

Wolves are found in the West of Asia; in Poland, Hungary, Austria, France, Italy, and Spain.[1] They were formerly very abundant in England, but were extirpated by Edgar,[2] the Peaceable, one of our Saxon sovereigns.

II. Description of the Wolf.

The internal structure[3] of the dog and of the wolf are so similar that anatomists have not been able, without difficulty, to detect any difference. In fact, they were once considered to be one and the same animal, the one in a wild state, the other tame. The chief difference in appearance between the wolf and the dog, is, that the eye of the former opens slantingly upwards, in a line with the nose, while

METHOD.

There is a wild animal very like our dog. Can you tell me its name? **The Wolf.**

[1] Shew these countries on the map.

[2] How was this done? Refer to the old practice of paying rents *in kind*.

[3] The build or make of its inside.

that of the latter is more at right angles with the nose, as is also that of man.

(*a*) HEIGHT. From 2½ to 3 feet.[4]
(*b*) LENGTH. From 3 to 4 feet.
(*c*) EARS. Long and erect.[5]
(*d*) TAIL. Long and bushy.
(*e*) NOSE. Pointed like that of a greyhound.

[4] Compare with objects in the room.

[5] Elicit the names of other animals having erect ears.

III. Habits.

Wolves are very cunning.[6] They generally associate in herds containing from 300 to 400. These are called "packs." They are most destructive in winter when the severity of the weather renders their ordinary prey scarce. They will then devour anything they can get, often attacking sheep folds and carrying off calves and even dogs. They are very voracious[7] and have an acute smell, so that they have been known to detect a carcase three miles off, and sometimes have followed an army to battle in order to feed on the dead bodies.

[6] This is proved by the fact of their forming a crescent (explain this shape) when they wish to capture any animal.
(Illus: by the games of boys.)

[7] To illustrate this give the anecdote of a gentleman travelling in Poland, whose life was saved by the shedding of his servant's blood.

IV. Uses.

(1) As dogs. By the natives of North America for hunting. This was before dogs had been introduced into the New World.

REMARK. In the East they are taught to dance and to play a variety of tricks.

THE BEAVER.

MATTER.

I. Where found.

Beavers are found principally in America, but there are a few in some of the largest rivers of Europe, as the Danube.[1] They were once common in this country, but have gradually disappeared.[2]

II. Description of the Beaver.

(*a*) LENGTH. About 3½ feet. } [3]
(*b*) HEIGHT. About 1 or 1½ ft. }
(*c*) FEET. The beaver is the only quadruped which has its hind feet webbed.[4] The front feet being intended to serve as hands are *not* webbed.
(*d*) TEETH. Like those of a rat or a squirrel, but stronger. They are useful in stripping off bark, or cutting timber.[5]

METHOD.

I wish to speak to you to-day about a curious animal found in or near rivers. It is **The Beaver.**

[1] Shew on the map.

[2] Show how civilization has intruded upon their haunts.

[3] Compare with surrounding objects.

[4] Explain and illustrate by the duck's.

[5] Operations necessary in the construc- of its house.

(*e*) TAIL. Flat and somewhat oar-shaped.[6]

(*f*) BODY. Covered with fur of either a glossy brown or black colour.

[6] Draw one on the blk. bd. and explain why it is thus shaped.

III. Habits.

Beavers are very sociable.[7] They unite in large numbers to construct their dwellings.[8] Their first object is to choose a running stream, across which they build a dam, always taking care to have a dry place to sleep in.[9] Their houses, which are generally begun in August, contain several apartments, each occupied by a separate family. Mud is the material of which these houses are constructed; it is fastened together by means of sticks and straw. They are completed before the winter sets in severely.[10] Beavers feed principally on the bark of trees: they are especially fond of willows and poplars. In summer they eat herbs.

When vexed they will cry like young children.[11]

[7] Fond of society.

[8] Notice their instinct, in thus *uniting* to construct their houses.

[9] Again observe their instinct, which prompts them to provide a *dry bedroom*.

[10] Why? So that the frosts may act as cement (show how).

[11] So much so that a gentleman about to shoot some of them, refrained from so doing, because their cries so reminded him of his children.

IV. Uses.

(1) Skin. Used for making "beaver" hats, also for muffs and tippets.

(2) Flesh. Considered a dainty by the fur-traders and North American Indians.

THE LLAMA.

MATTER.

I. Where found.

Llamas are found almost exclusively in the mountain regions of Peru and Chili;[1] in fact the llama may be called "the camel of the New World."

II. Description of the Llama.

(*a*) COLOUR. Sometimes black or white, but mostly brown.

(*b*) HEIGHT. About 4½ feet,[2] exactly that of the reindeer.

(*c*) LENGTH. From neck to tail nearly six feet.

(*d*) EARS. Like those of a donkey, very long, and generally carried erect.

METHOD.

Elicit from the class the names of some materials used in making dresses, and thence arrive at the subject of the lesson—**The Llama.**

[1] Shew on the map.

[2] Comp. with surrounding objects.

(*e*) FEET. Cloven,[3] each part having a broad elastic pad beneath it.

III. Habits.

The llama lies down to be loaded.[4] The average weight of its burden is from 80 to 100 lbs. It is very sure-footed,[5] and, consequently, can travel safely over the rough roads of its native country. When not working, it browses on coarse herbage in the day time, and spends a great portion of every night in chewing the cud[6]. When irritated it discharges a quantity of spittle from its mouth, which fluid, the Indians say, is poisonous. The llama is a very timid animal, often fleeing at the sight of man.

IV. Uses.

(1) Wool. Very fine and soft. It is manufactured into a beautiful material for dresses.[7]

(2) Flesh. Very good; much resembles mutton. Great numbers are killed annually for the sake of their flesh.

(3) Skin. When properly prepared makes very good leather.

[3] Ask for the names of animals having cloven feet.

[4] So does the camel.

[5] Comp. the goat, which also walks on rough roads, such as mountain paths, &c.

[6] Such animals are called "ruminating." Illus. by the cow.

[7] Called after the animal, "llama."

THE REINDEER.

MATTER.

I. Where found.

Reindeer are found in most mountainous countries of the Arctic regions,[1] especially in Lapland, where they are tamed, being so necessary for man's existence.

II. Description of the Reindeer.[2]

(*a*) HEIGHT. About 4½ feet.

(*b*) HEAD. Rather large for its body.

(*c*) HORNS. About 4 feet long, but those of the female are shorter. They are useful to the reindeer in digging the snow.[3]

(*d*) NECK. Long and carried level with its

METHOD.

What animals, having horns, do gentlemen in this country sometimes hunt? — **Stags.** Tell me an animal, living in a cold country, very much like a stag in shape. **The Reindeer.**

[1] Ask for the names of any countries in these regions.

[2] In treating this portion of the lesson shew God's wisdom and goodness as seen in the adaptation of the structure of animals to their mode of life.

[3] What for? To enable it to procure food.

shoulders.[4] Long loose hair hangs from it like fringe.

(*e*) FEET. Cloven.[5] When pressed on the ground they crack with a sharp sound.

III. Enemies.

The reindeer has many enemies: the principal of these are—

(1) Man, who hunts them because they are so useful to him.

(2) Gadfly. This fly stings them and then deposits its eggs in the hole thus made. In time the eggs are hatched, and large numbers of gadflies are thus produced. To avoid these insects, the reindeer climbs the highest hills it can find.[6]

(3) The Glutton. This is an animal similar to the sloth. It hides in a tree and there waits till a reindeer comes beneath it to sleep, when it attacks it.

(4) The wolf. It often happens that wolves are killed in their encounters with reindeer.

IV. Habits.

Reindeer are wild and very timorous, but they are easily tamed when young. They are very affectionate to those who are kind to them; but are also very revengeful towards their enemies. They so seldom sleep that the owner of a large herd could never detect any one of them dozing.

FOOD. In winter consists of lichen (a kind of moss, found under the snow);[7] in summer of coarse herbage, wild shrubs, and leaves of any trees which may be within their reach.

V. Uses.

(1) *When alive* the reindeer supplies to the Laplander the place of the horse and the cow. Two of them yoked to a sledge[8] can travel at considerable speed.

(2) *When dead.*

(*a*) Skin. Constitutes warm clothing.

(*b*) Horns. Make spoons and cups.

(*c*) Sinews. Make bowstrings and thread.

(*d*) Tongue. Is eaten.

(*e*) Legs. Furnish a rich kind of marrow.

REMARK. The wealth of a Laplander is computed according to the number of his reindeer, a rich man having sometimes more than a thousand.

[4] Not so with the horse.

[5] Comp. pig, sow, &c. Why cloven? So that it can easily travel without sinking in the ground or snow. (Illus. by reference to cows living near a river.)

[6] Why? Because gadflies, like other insects, are more numerous in warm climates; hence they generally frequent valleys.

[7] Sometimes this moss is so scarce that the only resource of the Laplander to save the life of his reindeer, is to cut down some pine trees and thus obtain the lichen which hangs upon their branches.

[8] Describe a sledge, and, if possible, sketch one upon the blk. bd.

THE CAMEL.

MATTER.

I. Where found.

Camels are found in Central and Northern Asia. There are two kinds, the Arabian, or one hunched, camel, and the Bactrian, having two hunches.[1]

II. Description of the Camel.

(*a*) HEIGHT. About 8 feet.
(*b*) COLOUR. Dark brown, inclining to red.
(*c*) TEETH. Very similar to those of a dog.
(*d*) STOMACH. The arrangement of the camel's stomach is very peculiar. Its food passes into one portion, while the other contains a large supply of pure water which it can drink at pleasure.[2]
(*e*) BACK. Some naturalists say that the hump on the camel's back disappears to supply it with food, and that when the body has been once more restored to its proper state, it returns.[3]
(*f*) LEGS AND FEET. Both well adapted to its mode of life. Its knees and feet are provided with elastic-like cushions.[4] Its feet are partly cloven.[5]

III. Habits.

Camels will not tread upon marshy ground if they can avoid it, hence their masters are sometimes bound to spread for them their tent coverings in order to induce them to proceed. They chew the cud[6] and are very vicious towards each other, camel fights being of frequent occurrence.

They feed principally upon thorny shrubs, date leaves, and beans.[7]

IV. Uses.

(1) *When alive.*
(*a*) As a beast of burden. It will travel 5 or 6 miles per hour with a load of 300 lbs.[8]
(*b*) Milk. A favourite beverage, that of the sheep and goats being made into butter.
(2) *When dead.*
(*a*) Flesh. Cut up and salted for food.

METHOD.

The last animal we spoke of was one living in very cold countries. To-day I wish to talk to you about one living in hot climates. What do you think it is called? **The Camel.**

[1] The latter is the true camel; that with one hunch is generally known as the dromedary.

[2] Here shew its adaptation to desert life.

[3] Probably this is fiction.

[4] By this arrangement it is enabled to kneel comfortably when being laden.

[5] Comp. the llama's, &c.

[6] Comp. the cow.

[7] The Arabs in providing for a long journey pound the date stones, and then feed their camels upon a kind of cake made by mixing this flour with water.

[8] More than two cwts. (In an upper class let this sum be worked.)

(*b*) Fat. Melted down and used as butter.

(*c*) Hair. The coarser kind made into clothing;[9] the finer into camel-hair pencils.

[9] Who wore camel's hair clothing? (*Vide* Matt. iii. 4.)

REMARKS. Camels are taught to kneel down to be laden, when very young. Every day, for some time their legs are bent under them, until they become able to kneel of their own accord, with facility.

They are also taught to endure hunger and thirst,[10] by causing them to fast frequently, for 5 or 6 days at a time.

[10] Why is such power of endurance necessary? Refer to desert life.

THE FOX.

MATTER.

I. Where found.

Foxes are found mostly in Europe, especially in the North and centre.

II. Description of the Fox.

(*a*) COLOUR. Brown, inclining to red, the under parts white.

(*b*) NOSE. Very pointed.[1]

(*c*) EARS. Erect and pointed.[2]

(*d*) TAIL. Straight, bushy, and tipped with white. There are three varieties of foxes, red, black, and blue: of these, the first is by far the most common.

III. Habits.

The fox forms its residence in a den or burrow[3] in the most secluded spot it can find.[4] It lies concealed during the day and prowls about at night for its prey, which often consists of game and poultry stolen from the farm yard. The fox has even been known to carry off a lamb. It will also readily devour rats and mice and is rather fond of fruit.

IV. Uses.

(1) Skin. Used for making muffs and tippets.[5]

(2) Flesh. Eaten as food in many parts of Europe.

(3) For hunting. Hunting the fox is a favourite field sport. Foxes have been known to run 50 miles, and after all to save their lives by wearying out the dogs and huntsmen.

N.B. To shew the cunning of the fox the following stories may be told:

(*a*) The Fox and the Twig. } *Vide Irish Third*

(*b*) The Fox and the Goat. } *Book.*

METHOD.

What is the principal animal hunted by gentlemen in this country? **The Fox.**

[1] Comp. that of the wolf.

[2] Elicit the names of other animals having erect ears. This will enable the teacher to ascertain if the word is understood.

[3] Comp. the rabbit, mole, &c.

[4] Why in a secluded spot? To be as far as possible from the reach of man.

[5] In order to ascertain if these articles are understood, ask the children their uses.

THE HORSE.

MATTER.

I. Where found.

Horses are found nearly all over the world. They are met with in a wild state in South America, having been introduced into that country by the Spaniards.

Probably horses came originally from Egypt.

II. Description of the various kinds.

(*a*) WELSH PONY. Found chiefly in Wales, hence its name. It is a small kind, and has long shaggy hair.

(*b*) SHETLAND PONY. Found, as its name implies, in the Shetland Islands.[1] It is very similar in appearance to the Welsh variety.

(*c*) The CART HORSE. Probably a breed obtained from the Dutch and Belgian horses, those of Flanders being highly esteemed at the present day.[2]

(*d*) The RACER. The most slender species; has long, thin legs, a short mane (often plaited)[3], and erect ears. One horse of this kind, called, on account of its great fleetness "Flying Childers," is said to have run a mile in a minute.[4]

(*e*) The HUNTER. Combines, to a certain extent, the agility of the race horse with the strength of the cart horse[5].

(*f*) The CARRIAGE HORSE. Similar to the hunter. They are noted for being so clean.

(*g*) The PACK HORSE. Very rare at the present time. They were formerly used as beasts of burden in this country, their load being slung across their back.[6]

(*h*) The ARAB. These are greatly prized by their masters, so much so that an Arab would rather part with anything than sell his horse. They are particularly affectionate, especially to the children of the family. Probably this is the result of great kindness shewn them by their master.[7]

The Arabs preserve the genealogies of their horses as carefully as we do those of our families.

III. Habits.

Horses are very sagacious and become much attached to their masters.

METHOD.

What animal do we employ to draw carts, carriages, &c. **The Horse.**

[1] Shew them on the map.

[2] In order to shew the strength of these horses, refer to the brewers' drays of London and other large towns. Some horses of this breed will draw as much as three tons.

[3] Why? To be out of its way when running.

[4] An idea of this great speed may be obtained by referring to an express train which generally travels 45 or 50 miles per hour.

[5] Shew why these qualities are necessary in a hunter—agility, to leap fences, &c.—strength, to endure the fatigue of a long run.

[6] Refer to the condition of our roads at the time (about 200 years ago), when these horses were so much used.

[7] Draw from this a lesson of humanity, and contrast such kindness with the brutal treatment some of our English horses receive.

They breathe *only* through their nostrils, the mouth never being found open, even after severe exercise, unless opened by the action of the bit. It is this fact which accounts for the expanding[8] of their nostrils after violent exertion.

[8] What does expanding mean? (Illus. by a blown bladder.)

IV. Uses.

Horses are used by most nations as beasts of burden and draught. They are also ridden. In Egypt they were formerly used to draw chariots.

THE CHAMELEON.

MATTER.

I. Where found.

In the continents of Asia and Africa :[1] on the grassy banks near rivers, and inland lakes.[2]

II. Description of the Chameleon.

(*a*) BODY. Long and tapering, and covered with hard scales.

(*b*) HEAD. Back part raised pyramidally.[3]

(*c*) EYES. Almost out of its head, yet covered with a skin. They move independently of each other.[4]

(*d*) FEET. Each foot has five toes, and consists of two parts, one containing three toes, the other two.

(*e*) TAIL. Long, round, and strong.[5]

(*f*) LUNGS. Frequently inflated, so as to make its whole body transparent.[6]

(*g*) TONGUE. Long ; moves quickly ; covered with a thick glutinous coating.[7]

REMARK. Chameleons are noted for changing their colour. They do not, however, borrow that colour from the neighbouring objects, as was formerly supposed. Their general colour is greenish grey. Before changing their colour their bodies are always inflated.

METHOD.

I wish to talk to you to-day about an animal of the crocodile tribe : it is called **The Chameleon.**

[1] Shew on the map.

[2] Why near water? Because in hot countries, flies, its principal food, swarm near water.

[3] Illus. by a sketch on the blk. bd.

[4] The eyes of most animals move both in the *same* direction. (Let the children try to look a different way with each eye, when they will find it impossible to do so. (The reason of this might be given to an upper class.)

[5] Why? To reach the branches of trees.

[6] Explain briefly the use of lungs. By way of illustrating the meaning of the word "inflated," refer to a bladder filled with air, or to a balloon.

[7] i. e., like glue. Why? To catch flies. (Illustrate by treacle papers placed in shop windows in the summer.)

THE CROCODILE.

MATTER.

I. Description of the Crocodile.

Crocodiles are of the lizard tribe: they have several peculiarities.

(*a*) TEETH. So placed that those of the lower jaw fit into corresponding cavities in the upper.[1]

They are conical[2] in shape, long and numerous.

(*b*) FEET. Differ from those of other animals in the number of toes. The back feet have five each, the front four.

(*c*) JAWS. Contain large cavities, in which is secreted a large quantity of poisonous fluid.[3]

(*d*) LENGTH. From 18 to 20 feet.[4]

II. Habits.

Crocodiles love basking in the sun.[5] They swim in the rivers for their prey, which consists of all kinds of fish and sometimes human beings.[6]

They generally toss their prey into the air:[7] then catch it and bolt it.

They cannot turn very quickly on account of their peculiar structure.[8]

They lay large eggs which are not unfrequently destroyed by mischievous flies, called ichneumons.

III. Mode of Capture.

(1) In Egypt. Best season is spring. Holes are dug, and the men hide behind the earth thus cast up. The crocodile comes to lay its eggs in the hole, and is speared.[9]

It then takes to the water and is pursued by men in canoes, who continue to spear it until it dies.

(2) In other parts of Africa. Natives in the water attack them with daggers, having previously enveloped their left arm in folds of cloth.[10]

(3) Ancient mode. By means of a hook, which was baited with pig's cheek. At the

METHOD.

Suppose for one moment you are in India or Egypt, on the banks of the Ganges or the Nile, you would probably see large animals lurking among the grass, or coming up out of the water. What are these animals called? **Crocodiles.**

[1] Illus. by diagram on blk. bd. or a cut apple.

[2] Like a sugar-loaf. Sketch one on the blk. bd.

[3] Object of this fluid. To pour into its bite and so render it more dangerous.

[4] Comp. with surrounding objects.

[5] What other animals do this?

[6] Why are human beings in the river? (Refer to Indian devotees; also to the cooling effects of river bathing.)

[7] Why? To get rid of the water it may contain.

[8] The vertebræ of the spine are very firmly knit, hence they are not so flexible. (Contrast the crocodile's spine with that of a serpent, or with our own.)

[9] Draw a spear on blk. bd. (Refer to the whale fishery.)

[10] Object of this. As a bait for the crocodile: while he is biting at this, the natives have time and opportunity to stab him to death.

same time a pig was made to squeal, when the crocodile, imagining he was killing it, was then got on shore, blinded and killed.

IV. Uses.

Crocodiles are of use only to the natives of those countries in which they are found.

(1) Flesh. Not very palatable, because so strongly scented with musk, which is a perfume secreted in the glands.

(2) Worshipped by the Egyptians. Hung with jewellery; fed with cakes and wine. When dead they are embalmed.[11]

N.B. The crocodile is supposed to be the leviathan mentioned in the Book of Job (*vide*, chap. xli., *v.* 1.)

[11] Explain, briefly, the process of embalming. (Illus. by reference to the British Museum.)

THE OSTRICH.

MATTER.

I. Where found.

Like the camel, the ostrich is found in the deserts of Asia and Africa.[1]

II. Description of the Ostrich.

(*a*) HEIGHT. From the top of the head to the ground, is from 7 to 9 feet; from the top of the back from 3 to 4 feet.[2]

(*b*) HEAD AND BILL. Very much resemble a duck's. The head is carried erect.[3]

(*c*) EYES. Like those of the camel: long lashes and overhanging eyebrows.

(*d*) BODY. Covered with valuable feathers, mostly black and white.

(*e*) FOOT. Very strong; has two toes, the inner larger than the outer, which is furnished with a claw; the inner toe being clawless.

(*f*) TONGUE. Small and rounded at the tip.

III. Habits.

Ostriches live in herds or flocks. They are frequently found with Zebras.[4]

In the South of Africa they do great damage to the crops of the farmers, so much so that nothing is left standing but the stalks of the plant. They are very quick of hearing and are

METHOD.

I am going tell you to-day, about a very large bird; it is **The Ostrich.**

[1] Shew on the map.

[2] Comp. with surrounding objects.

[3] i.e., upright. Elicit the names of other animals which carry their heads in this manner.

[4] What are Zebras? Beautifully striped animals of the horse kind.

consequently difficult to capture. Their sense of smell is also very acute, hence the hunters always take care to approach them on the leeward side.[5]

Ostriches are the most voracious of birds.[6] They will devour leather, grass, hair, iron, &c. Their ordinary food consists of shrubs, plants, and various kinds of seeds.

IV. Uses.

(1) To hunt. They must be approached very cautiously and without noise.

(2) For their plumage. The feathers of ladies' hats are frequently those of the ostrich. They are very light: a pound will contain 80 or 90, and will sell for from three to ten guineas, according to their quality.

(3) For their flesh. It is very palatable. So are their brains. Heliogabalus, one of the Roman emperors. once had the brains of 600 ostriches served up at a banquet.

(4) For their eggs. These are 8 inches long and 4 broad,[7] and are considered a very great dainty. The ostrich lays them in the sand, consequently those who procure them must be careful to leave no foot-prints.[8]

An ostrich egg is supposed to contain as much as two dozen hens' eggs.

REMARKS. Ostriches are hunted by the Arabs on horseback. As they are so fleet it would be next to impossible to capture them, but for the fact that they run in a circular orbit.[9] The locomotion of the ostrich may be regarded as half flying, half running.

[5] The opposite direction to that from which the wind blows. Why? That they may not be scented.

[6] They have been known to devour parasol handles. (Inst. of one which did so in the Zoological gardens, London.)

[7] Draw these dimensions on the blk. bd. in order to give the class an idea of the size of the egg.

[8] Why? Because the ostrich would provide another place for laying.

[9] Explain this.

THE CUCKOO.

MATTER.

I. Where found.

Cuckoos are found in most of the countries of Europe, but they occasionally visit the other continents.[1]

II. Description of the Cuckoo.

(*a*) COLOUR. Cuckoos change colour as they moult,[2] but on reaching maturity they become black on the back and head, and white with black spots underneath. Their tails are tipped with white.

METHOD.

What bird do we often hear during the months of April and May? **The Cuckoo.**

[1] Hence they are migratory. (Illus by reference to the swallow.)

[2] What is moulting? (Illus. by reference to poultry.)

(*b*) BACK. Has a hollow in it near the neck. This is used to aid it in ejecting birds from their nests.

(*c*) CLAWS. Long and sharp.

III. Habits.

Cuckoos have no feeling for their young. In this respect they differ remarkably from other birds. They build no nest of their own, but appropriate the structures of other birds, generally choosing those of the hedge-sparrow. Their note is mostly a falling third.[3]

Their eggs are small. Their food consists of small insects which they catch with great rapidity.

[3] Explain this (if the class be an upper one) by reference to the scale.

IV. Use.

To destroy noxious insects.

THE WOODPECKER.

MATTER.

I. Where found.

The woodpecker is very widely distributed: in fact there are only two places where they are not found. These are New Holland, and the South-Sea Islands.[1]

II. Description of the Woodpecker.

(*a*) LENGTH. About four inches.[2]

(*b*) BILL. Chisel-shaped, hence called "the carpenter of the woods."[3]

(*c*) TOES. Very strong, especially the hinder ones.[4]

(*d*) TAIL. Composed of short, strong feathers. These afford a prop in climbing.

(*e*) TONGUE. Is a wonderful contrivance. It is furnished with a powerful muscle so that it can be protruded or retracted[5] very quickly. It is also tipped with hairs.

III. Habits.

The woodpecker climbs very rapidly, and in so doing moves its head backwards and forwards.[6] It taps (hence its name) at the bark. This causes the insects to come forth, when they are eaten. The tongue of the woodpecker

METHOD.

There is a bird which peels the bark off old and decayed trees: what is its name? **The Woodpecker.**

[1] Shew on the map.

[2] Draw a line of this length on the blk. bd.

[3] Why is its bill thus shaped? To enable it to peel off the bark.

Shew how comparatively useless it would be, if it were pointed like that of most birds.

[4] Why? To assist it in climbing.

[5] Explain these words. (Illus. by a cat's claws.)

[6] Why? In searching for insects.

is most useful in catching insects. It can cover it with a glutinous[7] fluid, so that when the insects once come in contact with it they cannot escape.

IV. Use.

To destroy noxious insects.[8]

[7] Like glue.

[8] Shew that they do not, at the same time, destroy the trees, because they are old and rotten.

BIRDS.

MATTER.

I. General Description.

(*a*) NECK. Longer than those of quadrupeds and also more moveable. The length of the neck is determined by that of the legs.[1] Birds which derive their food from the water have very long necks.[2] That of the swan exceeds the length of its body.

(*b*) BONES. So constructed as to combine lightness with strength. In full-grown birds the bone is filled with air instead of marrow. This is only the case, however, with birds which fly, as the eagle, swallow, &c.

(*c*) TEMPERATURE OF BODY. Much higher than that of man. The average temperature of the human body is about 100°, while a thermometer[3] placed under a bird's wing frequently reaches 105° or 110°. This enables them to withstand such a degree of cold as would prove quite insupportable to us.[4]

(*d*) COVERING. Composed of feathers: sometimes compact and firm, as those of the eagle; at others, loose and curling, as those of the ostrich; while a third kind are like the scales of a fish. A wise provision is manifest in the feathers of aquatic birds.[5] They are intended to be waterproof, hence we find in the glands, near the tail, an oily fluid, which is spread by the bird over its feathers and constantly renewed. By this arrangement the body is not only rendered waterproof, but also kept warm. The feathers have three names, according to their position on the wing. Those on the part of the wing corresponding to our hand, are called "*primaries;*" those on the middle portion answering to our fore-arm, "*secondaries;*" those on the upper part corresponding to our upper-arm, "*tertiaries.*"[6]

METHOD.

We will have a lesson to-day upon **Birds.**

[1] Explain this.

[2] Ask for the names of some.

[3] What is a thermometer? In an upper class derive the word.

[4] As a proof of this the fact of a humming bird living at Terra-del Fuego may be mentioned.
(This would need a little explanation.)

[5] Birds living in or near water, as seagulls and ducks.

[6] These words signify 1st, 2nd, and 3rd. (Derive them in an advanced class.)

(*e*) FLIGHT. The wings can be expanded or closed with great rapidity. They can also be compressed into a very small compass. The length of time birds can continue on the wing is astonishing; *e.g.*,[7] swallows in building their nests and feeding their young, also, the Frigate, a man of war bird, which is often seen 1000 miles from land.

Their strength and power of descent are well seen in the gannet, a bird found on the coasts of Scotland and Cornwall.[8]

(*f*) SENSES. The senses mostly distinctly marked in birds are:—

(1) Sight. Birds have three eyelids. By means of the third they can completely cover the eye with a semi-transparent substance. It has been asserted that it is on this account that the eagle can gaze upon the sun.

(2) Smell. Very strong, especially in vultures[9] and other birds of prey.

(*g*) ORGAN OF VOICE. By the aid of their vocal organs many birds may be taught to imitate the human voice.[10] This power of imitation attains its highest perfection in the mocking bird of America, which has been known to imitate dogs, chickens, the mewing of cats, or the creaking of a wheelbarrow.

The plumage of birds is periodically renewed. This is termed—

II. Moulting.

It is accomplished in various ways.

(1) By the feathers themselves becoming altered in colour.

(2) By the addition of new feathers, without shedding the old ones.

(3) By the entire moulting.

III. Nests.

The nests of birds shew a great diversity of structure, situation, and materials.[11]

Some of the nests of English birds are very ingeniously constructed; *e.g.*, Twinks:[12] yet they are surpassed by those of foreign countries; *e.g.*, the Tailor bird.[13]

Some birds have a common covering for their nests; *e.g.*, the Sociable Grosbeak,[14] which is found principally at the Cape of Good Hope. As many as one hundred nests of these birds have been found under the same cover of foliage.

[7] Refer to the fluttering of the swallows against the wall during these operations.

[8] One pounced upon a plank 1½ inch thick, and pierced it through.

[9] Dead bodies are scented by these birds at very great distances.

[10] Ask for examples.

[11] Contrast that of the wren with the skylark's: also the raven's with that of the goldfinch.

[12] Explain the construction of this bird's nest.

[13] Why so called? Sketch the nest of this bird on the blk. bd.

[14] Why called "Sociable?" (Contrast the bear.)

Shew the cruelty of robbing birds' nests, referring to the great amount of labour involved in their construction.

THE WHALE.

MATTER.

I. Where found.

Whales inhabit the Northern Seas, though some few have been caught in the South. The chief fisheries are prosecuted near the islands of Spitzbergen and Nova Zembla, and off the coast of Greenland.[1]

II. Description of the Whale.

(*a*) SIZE. The largest animal in existence: it has been known to exceed 90 feet in length.[2]

(*b*) COLOUR. Red, others are black, some are mottled.[3]

(*c*) HEAD. About one-third the length of the whole body. The under lip is much broader than the upper, which is narrow and oblong. This upper lip has two orifices[4] through which the whale spouts forth water, either for sport, or when wounded.

(*d*) MOUTH. Very large: furnished with whalebone instead of teeth.

(*e*) TONGUE. Soft and spongy. Consists of a fat substance, which frequently yields five or six barrels of oil.

(*f*) GULLET[5]. Very small for so large an animal; seldom exceeds four inches in diameter.[6]

(*g*) EYES. Not larger than those of an ox, but placed at a much greater distance from each other.

(*h*) FINS. Generally on the back or sides of the fish. Not so with the whale, for they are under each eye and serve as oars.[7]

(*i*) SKIN. Very smooth and slippery. Under it is the fat or blubber, which has frequently been known to yield 200 barrels of oil.

(*j*) FLESH. Red and coarse, something like beef. It is eaten by the Greenlanders.[8]

III. Habits.

The common Greenland whale is generally seen upon the surface of the water, apparently asleep, but on being attacked it dives rapidly, sometimes to the distance of a quarter of a mile, at the rate of seven or eight miles per hour. Sometimes they raise themselves perpendicularly[9] and lash the water with their tails, so as to be heard two or three miles off. This is called "lob-tailing." Whales seldom remain

METHOD.

What is the name of the largest animal found in the sea? **A Whale.**

[1] Shew these on the map.

[2] Compare with school-room.

[3] Illustrate by reference to soap.

[4] i.e., holes or openings.

[5] The narrow part of the throat, called also the "swallow."

[6] Some whales would be choked by a penny roll.

[7] Show how.

[8] Who are they? The inhabitants of Greenland.

[9] i.e., upright. (Illus. by the upright stroke of a T on a wall.)

under water more than ten minutes at a time, and never more than twenty. When they rise they generally blow eight or nine times, and remain upon the surface of the water about two minutes. Their

FOOD consists of small animals. When they wish to feed they descend with great rapidity, and with widely-extended jaws. Consequently, a stream of water enter their mouths, and, along with it numerous small fish. The water flows out again through the sides of their mouth, but the food is masticated by the whalebone, which is so closely arranged that not the least particle escapes.

Whales are generally solitary,[10] or in pairs. They are very fond of their young.[11]

[10] Alone: compare the bear.

[11] Give the story of a whale and her cub to prove their affection for their young.

IV. Differences between Whales and Fish.

(1) Fish are produced from spawn; whales are brought alive into the world.

(2) Fish are cold-blooded; whales are warm.[12]

(3) Fish can breathe under the surface of the water; but whales come up to breathe.

[12] Why? Because they live in *cold* seas?

V Uses.

(1) Whalebone. Used for stays, umbrella frames, &c.

(2) Spermaceti. Made into ointment, and affords a valuable oil.

(3) Blubber. Yields a great quantity of oil.

REMARKS. The fat, or blubber of the whale, being a bad conductor of heat, prevents its escape, and consequently keeps the whale warm.

"It is thought that it was some other fish, probably the shark, which swallowed Jonah, as the gullet of the whale is so small."[13]

[13] This inference is also supported by the fact that whales are very rarely found in the Mediterranean—the scene of Jonah's casting forth. (*Vide* Jonah i. 15, 17.)

THE COD.

MATTER.

I. Where found.

Chiefly on the sand banks of Newfoundland and Nova Scotia. Few are taken North of Iceland, and they never reach so far South as Gibraltar.[1]

[1] Shew these places on the map.

II. Description of the Cod.

(*a*) HEAD. Very smooth.

METHOD.

We will talk to-day about a fish. It is the **Cod-fish.**

(*b*) COLOUR. On the back and sides dusky olive,[2] variegated[3] with yellow spots, the under parts white.

(*c*) BODY. Covered with small scales, which adhere[4] firmly to the skin.

(*d*) JAWS. At the angle of the lower jaw is a beard, very short, seldom exceeding the length of a finger.

(*e*) TONGUE. Very broad.

(*f*) TEETH. Has several rows like the pike. Also has teeth near the opening into its stomach.

(*g*) FINS. Three back fins, two at the gills, two on the breast, and two near the tail.[5]

[2] Dull green.

[3] Explain this word, and illus. by reference to laurel or holly.

[4] i.e., Stick. Illus. by reference to a stamp or adhesive envelope.

[5] Object of these fins. (Illus. by reference to an oar.)

III. Habits.

The favourite haunt of the cod is shallows or sand banks. They resort to cold seas to spawn. Having deposited their eggs they repair to southern seas to procure food.[6]

The cod is one of the most prolific of fish: nine millions of eggs have been counted in the roe of an average-sized one. They begin to spawn in January.

FOOD. Small fish and worms. Crabs and other shell-fish are dainties for the cod: its stomach dissolves the shells in which they are encased.

[6] Hence they are migratory. (Explain and illus. by the herring and swallow.)

IV. Use.

As an article of food. Spain and Italy import great quantities of cod-fish.[7]

REMARKS. The hook and line are the only implements used in taking cod-fish, and they are found in from sixteen to sixty fathoms of water.[8]

Fifteen thousand British seamen are employed in this fishery. An expert hand[9] will sometimes catch as many as 400 in a day. The largest cod ever taken was 5 feet 8 inches long, and weighed 78 lbs.

[7] Why? Refer to the religion of these countries, and explain.

[8] How deep is this? Let the class find out.

[9] i.e., a clever fisherman.

THE ANCHOVY.

MATTER.

I. Where found.

In the Mediterranean, off the coasts of France

METHOD.

Sometimes, in order to relish cold meat, we have a sauce with it. There is one kind, which is red. It is called "Anchovy Sauce,"

and Spain.[1] Gorgona, a small Island west of Leghorn, is the station of the principal fishery. They are also taken off the coasts of Cornwall.

II. Description of the Anchovy.

Anchovies belong to the herring tribe. They average about six inches in length: those caught off the coast of Cornwall, however, are sometimes seven-and-a-half inches long[2]. Their JAWS differ from those of most fish, the upper being longer than the lower.

III. Fishery and Mode of Curing.

The common way of catching anchovies is to light fires on rafts.[3] These fires attract the fish, which are then captured in large nets provided for the purpose.

Having been caught, the first operation in *curing* them is to take off the head.[4] This is one man's business, and it is generally done by pressing the head between the thumb and fore-finger. The fish are next placed in rows with a layer of salt between each row.[5] This is another man's work. After having lain thus, for some time, a brine is formed[6]. This is not changed.[7]

IV. Uses.

Anchovies are sometimes eaten, but they are caught principally for the making of sauce.

REMARK. Spurious substitutes are often sold as anchovy sauce. Whitebait (a small fish very abundant in the Thames) are often caught for this purpose.

and is made from a small fish. It is this fish about which I am going to speak to you.

[1] Shew on the map.

[2] Draw a line this length on the blk. bd.

[3] Rafts are planks fastened together so as to form one floating surface.

[4] Why taken off? Because they are so bitter, and, therefore, unfit for food.

[5] Illus. the advantage of division of labour. Each man becomes expert in his own particular duty and thus more work is accomplished.

Why are they salted? (Refer to salt's preservative quality.)

[6] Shew how.

[7] Why? Because the flavour of the fish would be gone. Shew how.

THE RATTLESNAKE.

MATTER.

I. Where found.

METHOD.

In passing through a wood in N. America you would perhaps hear a noise like a boy with a pair of clappers. This is caused by a snake, which on account of

the rattling it makes, is called **The Rattlesnake.** Let us say a few words about it.

Rattlesnakes are confined exclusively to the immense woods of North America.[1]

[1] Shew on the map.

II. Description of the Rattlesnake.

(*a*) SIZE. Rattlesnakes are from 4 to 5 feet in length. Some have, however, been killed which measured upwards of 8 feet.[2]

[2] Comp. with objects in the schoolroom.

(*b*) COLOUR. Orange, tawny,[3] and blackish on the back, ash[3] colour on the belly.

[3] Illus. "tawny," by reference to cats of the same colour, and "ash colour," by the tree.

(*c*) JAWS. Very peculiarly constructed so as to expand in taking food. Hence the rattlesnake feeds on larger animals than might at first sight be supposed,[4]

[4] Show how.

(*d*) TEETH. Curiously formed. Two of them contain venom.[5] These are in the upper jaw, one on each side. They are long, hollow, provided with a slit, and have a bag of poison at their root.

[5] What is venom? Explain: and shew how this poison is passed into the wound when the bite is given.

(*e*) TAIL. Is a most curious construction. It is this which gives its name to the snake. The *rattle* is composed of a series of loose bones. The age of the serpent can be told by counting them.[6] This rattle is heard only when the snake is angry.

[6] Here shew that the age of an animal or plant is in proportion to the time required for it to reach maturity: e.g., the whale; the oak-tree.

III. Habits.

The rattlesnake does not attack unless molested: on the contrary it will even flee from the approach of man. It loves basking in the sun, and, when thus enjoying itself, it lies coiled up.[7] When provoked it raises itself upon its tail, throws back its head and inflicts a deadly wound. So venomous is its bite that, after the most intense suffering, the unfortunate victim often lingers but a few hours.[8]

[7] What is a coil? (Illus. by a rope).

[8] Here shew that God has furnished most animals with a means of defence.

The snake is easily subdued by music. (Give the instance of one which followed an Indian playing a flute.)[9]

[9] Refer to the serpent charmers on the banks of the Ganges, as a parallel case.

It feeds on small worms, birds, squirrels, &c.

REMARK. It was formerly supposed that the rattlesnake could fascinate its prey, and thus overcome them. This notion, however, is now exploded, and the fact is that the self-possession of its victim is lost.[10]

[10] Shew the consequence of this.

SPIDERS.

MATTER.

I. Where found.

Spiders are found in most countries. There are as many as forty-seven different varieties in England. Some spiders frequent the crevices[1] of walls; others the fields; while others again are found in water or underground.

II. Varieties and General Description.

There are three principal varieties of spiders:

(*a*) The house spider.
(*b*) The underground spider.
(*c*) The water spider.

(1) HEAD. Defended by two claws with which it is provided for seizing its prey. When not in use these claws lie concealed in a sheath.[2]

(2) EYES. Spiders have eight eyes: two on the top of the head, two on each side, and two in the front.[3] With one of its side eyes it sees sideways forwards, with the other, sideways backwards. Its eyes are immovable and transparent.[4]

(3) LEGS. Same in number as its eyes. They are covered with hairs and have claws at the end of them. These claws are serrated on the under side.[5]

III. Description of Webs.

(1) HOUSE SPIDERS. All the webs of spiders are a compound of glutinous threads.[6] They are very fine: upwards of one thousand, would only make one as thick as a hair. These threads are furnished by the spider's body, and are so strong that they can bear a weight many times greater than that of the spider itself. In forming the web one end is fastened to one wall and the other to the adjacent wall. Then other threads are laid across. The shape of the spider's web is generally octagonal.[7]

(2) WATER SPIDERS. The water spider lives under water. It fastens the threads of its web

METHOD.

Suppose on a summer morning you take a walk in the fields, you may have observed, on the hedges, something which has the appearance of network.

What is this? Spider's web. Let us talk about **Spiders**.

[1] What is a crevice?

[2] Illus. by the cat's.

[3] Why so many? Refer to the vigilance of the spider.

[4] i.e., they can be seen through. Illus. by glass, &c.

[5] What is the object of this provision?

[6] Why glutinous?

[7] Eight-sided. (In an upper class derive the word.)

to plants or bushes. All these threads meet in one point and form a cocoon.[8] This it fills with air.[9]

(3) UNDERGROUND SPIDERS. These bore a channel underground and line it with mortar. They then make a self-acting door of earth and threads.[10]

N.B. Spiders lay eggs in a separate cocoon prepared for the purpose, and then die.

[8] Exp. and illus. by reference to the silk-worm.

[9] Why?

[10] Exp. and Illus. by a spring door.

IV. Uses of Spiders and their Webs.

Spiders are useful in two ways:

(1) They catch and kill flies and other insects, which would otherwise multiply and become a nuisance.

(1) Some kinds produce a material from which, in France, silk is manufactured.

Spiders webs are useful to the spider:

(*a*) As traps to catch their prey.

(*b*) As linings for their dwellings.

(*c*) As cocoons in which to deposit their eggs.

THE SNAIL.

MATTER.

I. Description of the Snail.

The snail belongs to that class of animals which have no backbone.[1] They are produced from eggs. At first both body and shell are very soft and small, but as the snail grows, its house grows and strengthens also.[2]

THE SHELL is formed of a substance within its body, and it can either make an entirely new one, or repair one which has been damaged.

THE HORNS. It has four horns: two long and two short. At the end of the long ones are its eyes. It can protrude or retract these at will.[3]

II. Habits.

Snails love a moist locality, hence they are

METHOD.

I dare say you have all noticed cabbages with holes in their leaves. These pieces have been eaten out. Can you tell me what has done this? **The Snail.**

[1] Ask for the names of other animals of this kind, Leeches, grasshoppers, ants, and beetles.

[2] Notice the wisdom of God in thus providing the snail with an ever-present means of defence.

[3] Explain these words, and illus. by reference to the claws of a cat, and shew that it retracts its horns when danger is near: hence the phrase "drawing in one's horns."

most frequently seen after rain.[4] Cold weather does not suit them. At the approach of winter they make doors to their houses, and, having shut themselves in, sleep till spring.[5]

As the warm weather advances they burst these doors and come forth in search of food.

III. Uses.

(1) As an article of food.

Especially are they used for this purpose in Germany, where snail gardens are kept, and children employed to look after them.[6]

(2) As a medicine.

They are said to be beneficial in cases of consumption.

[4] This is the opportunity seized by gardeners for destroying them.

[5] Shew how God has adapted each animal to the mode of life He intended it to lead.

[6] A practice somewhat analagous to this, is that of keeping frogs in France.

THE SILKWORM.

MATTER.

I. Where found.

Silkworms are still found principally in China. There are many in India and several parts of Europe, especially the South of France, Spain, and Italy.[1] The first silkworms imported into Europe were brought from China: it is said stealthily, by some monks, who secreted some eggs in a bamboo cane, and hatched them artificially on arriving in Europe.[2]

II. Description and Habits of the Silkworm.

The silkworm is a kind of caterpillar, not at all beautiful in appearance, but still most useful to man.[3] It is propagated from eggs, of which as many as 200 are sometimes produced by the same moth. In a few days they are hatched, and so small is the worm on emerging from the egg that 100 of them would not weigh more than a single grain.[4]

They have sixteen legs, and seven small eyes on each side of the head.

For the first few days the silkworm eats enormously, its principal food being the leaves of the mulberry tree, and it is a remarkable fact that no other living creature will touch these leaves.[5] When the worm has reached full maturity, it ceases to eat and begins to spin its web. This it does by drawing forth threads of

METHOD.

Can you tell me the name of any material of which ladies' dresses are made? **Silk**. Silk is produced by a small worm, called the **Silkworm**.

[1] Shew these countries on the map.

[2] Why all this precaution? Because we were not allowed to enter China, for the purposes of trade until within the last few years.

[3] Here shew that use should take precedence of beauty. (Illus. by a comparison of our English songsters with the birds of America.)

[4] i.e., 48000 would only weigh one ounce.

(Let this be quickly worked on the blk. bd., in order that the class may the more readily comprehend the statement.)

[5] This is a proof of the providence of God: a continual supply of food being thus secured to the silkworm.

silk, which are secreted in two hollows, one on each side of its body.

Each pair of threads is glued together as they are drawn forth, and their strength is such that they will sustain a weight three times as great as those of flax, and twice as great as those of hemp of the same size. The ball of silk thus spun is termed the *cocoon.* It is of an oval shape.[6] It consists of a thread upwards of a quarter of a mile long. This cocoon encloses the grub which in a few days changes into a chrysalis. When the cocoons are finished, they are put into an oven to kill the spinner.[7] The silk is then wound off the cocoon upon reels, in which state it is called *raw silk.* To obtain one pound of this silk, upwards of 2000 cocoons are required.

Before this silk is ready for the manufacture it must undergo several processes, some of which are cleansing, winding, and twisting.

[6] Illus. by an egg. An upper class may be told the derivation of the word "ovum" —an egg.

[7] Why? So that he may not eat his way out of the cocoon and so spoil the silk.

III. Uses.

Silk is employed:

(1) In the manufacture of various fabrics. The principal of these are—

(*a*) Dress pieces. These are mostly manufactured in France, the French excelling in this branch of industry, owing to their skill and the superiority of their designs. Spitalfields, a part of London,[8] and Macclesfield, in Cheshire, also manufacture silk goods.

(*b*) Ribbons of the most beautiful kind are made at Coventry, in Warwickshire.[9]

(2) Sewing threads, of various degrees of fineness, are much required for various purposes. No other kind of thread is so strong, or so beautiful.

(3) Stockings and gloves are also made of silk.

[8] Shew how the manufacture was introduced into this country, viz., by the Revocation of the Edict of Nantes, by Henry V. in 1685, and the consequent immigration of the French Protestant refugees to this portion of our capital.

[9] Shew on the map.

N.B. The teacher should make this lesson the means of inculcating in the minds of his scholars, *the importance of little things.*

HIVE-BEES.

MATTER.

I. Kinds of Bees.

In each hive there are three kinds of bees :—

(*a*) The DRONES. These are of a cylindrical shape.[1] They are the largest kind and have no sting. They form the minority in a hive (probably only one in seven is a drone). They are supposed to be the males.[2]

(*b*) The WORKING BEE. Of these there are two classes :—

(1) The nurse bee, whose duty it is to take care of the young ones.

(2) The wax-worker, which, as its name implies, labours to construct the combs, &c.

The working-bee is of a tapering form, is smaller than the drone, and is armed with a sting.

(*c*) The QUEEN. Of these there is generally one in each hive. Should there be more after swarming, they fight until only the strongest is left alive. She is then the queen of the hive.

II. General Description.[3]

Bees are divided into three parts :—the head, the chest, and the abdomen or stomach. In the tail is placed the

STING, which is very peculiar. It consists of a sheath, in which are two barbs, the one longer than the other. When it wishes to defend itself, it first thrusts the sheath into the flesh of its victim, then the long dart, and afterwards the shorter one. Poison is then poured into the wound, occasioning swelling and pain.

TRUNK. In order to enable it to extract the honey from flowers, bees are provided with a trunk, which differs from that of flies in being besom-shaped[4] instead of hollow. The bee can flatten its tongue like a trowel, or sharpen it like a pencil. Bees also have

TEETH, which are useful to them in making wax. Their

BODY is covered with short hairs ; hence, in order to collect the dust with which it makes the substance called "bee bread," it rolls itself

METHOD.

There is an insect which is continually flying from flower to flower, gathering honey ; what is its name? **The Bee.**

[1] Illus. by a lead pencil or piece of piping.

[2] From the fact of lazy people resembling drones, inasmuch as they do not work, we get the saying, "As lazy as a drone."

[3] From this head shew the class the wisdom and goodness of God in thus providing even insects with so wonderful a system of contrivances.

[4] Sketch on the blk bd.

in the flowers, and then brushes itself with its two hind legs.

LEGS. These are wonderfully constructed, each being furnished with a hollow like a basket, round which there are strong hairs like bristles, so that when heaped up the dust is thus prevented from falling over.[5] Its

ABDOMEN, or belly, contains not only the intestines, but also the honey bag,[6] the venom bag,[7] and the sting.

III. Habits.

Bees gather three substances :—

(*a*) HONEY, with a portion of which they feed their young, the remainder being laid up in the hive for use in winter, when there is no chance of obtaining any from flowers.[8]

(*b*) POLLEN, or BEE BREAD, which is a fine substance culled from various flowers, carried by the bee in its hinder legs, and kneaded with honey into round balls.

(*c*) PROPOLIS, which is a kind of reddish gum. This they use for two purposes :

(1) To stop up all crevices in the hive.

(2) For lining the cells of the honeycomb.

The HONEYCOMB is constructed in a very curious manner. Having eaten a sufficient quantity of wax the first bee hangs, by means of its claws, to the roof of the hive, the others hanging on in succession. In this way they work, the wax used being produced by their own bodies as they go on. The cells are hexagonal[9] in shape. When filled with honey they are sealed up, none of their contents being touched till winter.

BEES ARE PRODUCED in the following manner: The queen lays the eggs, sometimes as many as one hundred a day. In three or four days they are hatched, when a grub comes forth and is fed by the nurse bees for about a week. It then begins to spin its silken covering, afterwards turning into a pupa or chrysalis. In little more than another week, it becomes a perfect bee.

THE SWARMING. When the hive becomes too full, some of the bees leave it to seek a new home.[10] The adventurers are led forth by their queen, the flight taking place generally about the middle of May, or beginning of June.[11] When the whole swarm has risen into the air,

[5] Explain this.

[6] The honey bag is that which contains the honey. It is more frequently called the *bladder*, and will no doubt be familiar to many country children, who have probably killed bees to obtain their honey.

Here denounce cruel habits, at the same time prove that the mischievous one is in reality destroying the works of God.

[7] Another name for poison.

[8] Notice the foresight of the bee, and hence deduce the lesson of "providing for a rainy day."

[9] i.e., six-sided. Why? No other shape would so readily economise both space and material. This has been accurately demonstrated by mathematicians.

[10] A parallel custom is emigration by man.

[11] Notice the remarkable instinct of the bee. The hives are thus thinned before the intense heat of the summer comes on.

the queen settles on the branch of a tree and waits till her subjects have taken their places. This done, their owner shakes them off into a new hive. The following are a few of the

IV. Lessons Taught by the Bee.

(1) They teach us to be industrious.[12]
(2) They teach us to be loyal.[13]
(3) They teach us to be fond of our homes.
(4) They are models of cleanliness.
(5) They are very sympathetic.[14]
(6) They are very fond of fresh air.
(7) They are very early risers.
(8) They are very peaceful.[15]

N.B. This lesson may be divided into two parts, heads numbered I. and II. forming sufficient material for the first lesson, and those numbered III. and IV. for the second.

[12] Refer to the hymn, "How doth the little busy bee," &c.

[13] Fond of the sovereign.

[14] i.e., they feel for each other. They have been seen to carry a wounded one out of the hive into the sunshine, lick him with their tongue, roll him over and over, and, at sunset carry him back again into the hive.

[15] The sting of bees is purely defensive, i.e., they never use it to *attack* an enemy.

PART II.—THE VEGETABLE KINGDOM.

THE POTATO.

MATTER.

I. Where Grown.

Potatoes are grown in most civilized countries, both of the Old and of the New World.

About 300 years ago they were unknown in the British Isles, though in America they were in common use among the natives long before that time.

II. Description of the Plant.[1]

The potato consists of five parts :—the root, the stem, the leaves, the flower, and the apple.

III. Cultivation.

Potatoes may be raised either from seed or from the plant, but it is by means of the apple that new kinds are introduced; indeed, most kinds are commonly propagated in this way. Having chosen his soil and well manured it, the farmer plants his seed (either whole or cut into parts according to the situation of the eyes[2]) in ridges or butts made by the plough.[3]

METHOD.

When we eat meat we generally like some kind of vegetable with it. Tell me the name of a very common vegetable. **The Potato.**

[1] As the potato is so well known in this country, elicit, as much as possible, of this head from the class.

[2] Explain the process.

[3] This process differs in various parts; some farmers plant in ridges, others in butts wide enough to admit of 3 or 4 rows of potatoes in each.

As the plant grows it must be earthed up and also kept free from weeds, hence the operation of hoeing.[4]

When fully ripe the stalks wither. It is then time to gather in the crop, for which purpose a three-pronged fork[5] is employed.

REMARKS. Potatoes were first introduced into England by Sir Walter Raleigh, in the reign of Queen Elizabeth. He brought them from Virginia.[6] At first people received them very cautiously, and refused to eat them because they are not mentioned in the Bible. By degrees they became not only generally adopted, but the chief vegetable used.

From the potato we may obtain starch, sugar, and flour; hence it is, that some people substitute it for bread.

No special head entitled "Use," has been adopted in this lesson, the familiarity of the subject rendering it superfluous.

[4] Why earthed up? Illus. by reference to celery.

Why weeded? Because weeds spread and leave no room for the plant to flourish.

[5] Illus. the word "prongs," by reference to a dinner fork.

[6] Shew on the map.

N.B. The teacher may conclude the lesson by asking the children to name a few varieties, eliciting from them, if possible, their chief characteristics.

THE MAHOGANY TREE.

MATTER.

I. Where found.

Mahogany trees require a very warm climate. They grow chiefly in the West Indies (especially in the Island of Cuba) and Honduras.[1]

That growing in Cuba is called Spanish mahogany, because the island in which it grows belongs to Spain.

II. Description of the Tree.

The mahogany tree is one of the most beautiful trees in the countries where it is found. Its trunk is large and its foliage thick. It is produced from a seed, which, blown about by the wind,[2] alights upon a thin layer of soil and so takes root. It not unfrequently happens that mahogany trees are seen growing between rocks, where there appears to be a scarcity of soil. This is accounted for thus:—the seed has been carried between the crevices by the wind, and as it increases in size, has forced the rocks asunder, thus throwing off large portions of stone and gradually making room to grow.[3]

METHOD.

Some of the furniture in a gentleman's house is made of an expensive kind of wood. Tell me the name of one. **Mahogany.**

[1] Shew on the map.

[2] Hence called "winged-seed." (Illus. by reference to the seed of a thistle.)

[3] Here the lesson of great results from small beginnings may be appropriately illustrated.

III. How obtained.

Workmen hew the tree standing upon a scaffold[4] erected for that purpose. When the tree is cut down, the next business is to divide the trunk into logs: these are then drawn on carts by oxen to the water-side, where, having been first marked with the initials[5] of the owner, they are allowed to float down the river, the men following them in boats. Arrived at their destination each party separates its logs and they are then made ready for shipment.

[4] Illus. by builders.

[5] What are initials? Require the class to give the initials of their names, in order to ascertain that they understand the meaning of the words.

IV. Uses.

(*a*) Mahogany is used for making articles of furniture such as tables, chairs, &c.; also for fancy articles, as workboxes.

(*b*) It is also used as a veneer, i.e., it is cut into thin layers, which are laid upon commoner woods, so as to give them the appearance of mahogany.[6]

REMARKS.—Mahogany was introduced into England about the end of the seventeenth century. Captain Gibbon, of a West Indian vessel, brought some logs to England, and his sister-in-law had a candle-box made of a portion of them. The carpenter, at first, refused to execute the order, alleging that the hardness of the wood spoilt his tools: at last, however, he succeeded, and the box becoming a curiosity, attracted the notice, among others, of the Duchess of Buckingham, who had a bureau made of the same material. Thus patronized, the wood soon became extensively used.

[6] Ask for the names of other woods used in this way; *e.g.*, rose-wood, box, maple, &c.

THE COCOA-NUT TREE.

MATTER.

I. Where found.

Cocoa-nut trees are found in the Polynesian Islands, where they grow wild. In Ceylon, Sumatra, and Java, the tree is cultivated.[1]

II. Description of the Tree.

(*a*) HEIGHT. From 60 to 90 feet. They are fond of a maritime situation,[2] their roots sometimes are even washed by the sea.

(*b*) TRUNK. Straight and without leaves.

METHOD.

Let the teacher provide himself with a cocoa-nut, which he might exhibit to the class, at the same time asking its name.

[1] Shew on the map, and draw attention to the fact that the fruit, &c., of wild trees and plants is far inferior to that of cultivated ones. (Illus. by the strawberry.)

It is covered at intervals with black rings, which if counted would give the age of the tree: one of them being formed half-yearly by the falling off of leaves.

(*c*) LEAVES. All at the top of the tree, after it has attained its full growth. When growing, the leaves are formed as we have seen and fall off again, all but those at the top of the tree. The leaves hang over the trunk in the shape of an umbrella.[3] There are from 12 to 14 leaves in all.

(*d*) BLOSSOMS. White. Seen a little way off, they look like bunches of down.[4] They are replaced by a fresh cluster every five or six weeks.

(*e*) THE FRUIT is found in bunches under the leaves. Each nut is enclosed in a thick husk, and weighs from 15 to 20 lbs.[5]

III. Sketch of a Plantation.

Suppose we were to go to Ceylon, which is an island S.E. of India.[6] We should there find portions of land appropriated to the cultivation of cocoa-nut trees. Each of these plantations,[7] as they are called, is enclosed by a high fence.[8] At one corner of the plantation is a watch tower, in which a man is constantly stationed to keep guard over the plantation. The watchman is a Malay,[9] and he is armed on account of the thievish nature of the Cingalese.[10]

Suppose we entered the plantation we should most likely meet a second man, armed with a long gun,[11] and with a girdle round his waist. We see also a set of boys with a sharp instrument and a part of a nut-shell, slit lengthways and hanging from the wrist. These boys climb the trees to kill the cocoa-nut beetle, which has bored into the trunk and penetrated to the core of the tree during the night. Here it lays its eggs, and it is the business of these boys to clear away all the eggs and rubbish, and having found the beetle, to kill it.

Another set of boys is employed to look after unhealthy trees. They are provided with a bill-hook,[12] with which they clear away the dirt from the bottom of the trunk. They are then almost certain to discover a worm, about four inches[13] long, with a black head and white body. Having killed this, the holes are stopped with clay, and in a short time the tree revives.

[2] i.e. Near the sea. In an upper class give the derivation.

[3] Sketch this on blk. bd.

[4] What is down? Refer to ducks and geese.

[5] Shew what a quantity of fibre must envelope the nut, inasmuch as the latter by itself weighs not more than 1½ or 2 lbs. (Refer to apple and nut stalls in this country.)

[6] Point to it on the map.

[7] Illus. by plantations of trees in this country.

[8] Made to keep out thieves and wild animals.

[9] i.e. a native of the island so called.

[10] Natives of Ceylon. Draw attention to the fact of foreigners being trusted by the planters, in preference to natives of the island.

[11] To shoot squirrels, &c., which are fond of nuts.

[12] What is this? Illus. by reference to wood-cutters in this country, and sketch one on the blk. bd.

[13] Sketch this length on the blk. bd.

At night fires are lighted outside the fence.[14] Porcupines are very mischievous to these trees: traps are set to catch them.

N.B. Here the Teacher might explain how by means of a rope and a bag round his waist, the young Malay gathers the fruit.[15]

IV. Uses.

The Cocoa-nut tree is one of the most bountiful provisions made by our Creator for the inhabitants of the Torrid Zone. It is so important that the Cingalese desire it in preference to anything else.

The TRUNK furnishes beams and rafters for their habitations.

The LEAVES make an excellent thatch, common umbrellas, and coarse mats.

The NUTS form an article of food, and

The MILK they contain is a nutritious drink.

The OIL is expressed from the kernel, and employed in the manufacture of candles.

The KERNEL is afterwards given as food for the cattle and poultry, or used as manure.

The SHELL makes drinking cups and spoons, and before they are full grown, are used as bowls for pipes.

The HUSK is manufactured into ropes and cordage of every description, from the smallest twine to the stoutest cable. From

The BUDS—a spirit called "arrack" is distilled.

[14] Why? To drive away hogs and elephants, the former destroying the bark of the tree, and the latter trampling down young trees, or tearing them up by the roots.

[15] This might be illustrated by reference to the gathering of dates, as narrated in Book III. of Irish Series.

FLAX.

MATTER.

I. Where found.

The flax plant is grown principally in Russia, the Netherlands, and France.[1]

II. Description of the Plant.

The flax plant is an annual.[2] It sends up smooth, slender, upright stems, about as thick as a crowquill. They are hollow and are surrounded with fibres. It is these fibres which are manufactured into linen. The plant is about two or three feet in height: has long, narrow leaves of a greyish colour, growing alternately on the

METHOD.

Can you tell me of what gentlemen's shirts are made?—**Linen.** Linen is made from **Flax.**

[1] Shew these countries on the map, and explain the meaning of the word "Netherlands."

[2] Why so called? Because they are raised annually. (Illustrate by reference to flowers.)

stem. It bears a pale blue flower, containing five petals. The blossoms open in July and are succeeded by globular seed vessels, each containing nine or ten seeds. These are the *linseed* of commerce, the oil of which is so much valued, and the husks[3] form the linseed cake so generally used for fattening cattle.

[3] i.e., the shells, after the oil has been expressed.

III. Cultivation of the Plant.

Flax requires a rich soil; gravelly or cold clayey soils would be fatal to it. Its cultivation was once extensively carried on in England until corn-growing was found more profitable. The growing of flax requires considerable capital, for between each sowing the land must receive other crops. These sowings take place at intervals of six or seven years. Barley or turnips are often sown preparatory to flax, and after these crops have been gathered, the ground is manured by peat ashes (30 bush. to an acre). These are harrowed in, after which the soil is dressed with liquid manure, which is left to soak eight or ten days.

SOWING. The seed is now sown in the proportion of 160 lbs. to an acre. It is then covered with a bush harrow, but only buried about half-an-inch, otherwise it would not vegetate. In southern climates flax is grown during the winter, and pulled in spring. In our own country it is sown in March or April and pulled in the summer. If quality of fibre be the object of the sower, it is sown delicately, and hence the stems are delicate. If, however, seed be his object, he sows a less quantity. In this case the stalks are strong and coarse, much branched at the top, and an increase of seed is the result. Flax seed from Riga[4] is generally considered to yield the most abundant crop. When the plants are two or three inches high,

[4] Shew this place on the map.

WEEDING commences. In Flanders this is performed by women and children, who are provided with coarse cloths, and creep along on their hands and knees. This is not so injurious to the young plants as walking on them. The weeders are also particular as to their position with regard to the wind. They turn *towards* the wind, so that the flax, which has just been bent down by them, may be raised again. A delay in weeding often proves fatal to the young plant as they often become bruised when grown

too high. Flax, especially the taller kinds, requires support. This is afforded it in two ways: stakes are driven into the ground eight or ten inches apart. To these, rods are fastened by means of osiers,[5] about 18 inches from the ground. A number of these rows parallel to one another, will support a field of flax. Another plan is to drive a number of stakes into the ground, pretty closely together, and fasten to them ropes, crossing each other.[6] The

HARVEST depends on the season and intention of the sower. If fineness of fibre be his object, the flax is pulled green; but, if quality of seed be his aim, a longer time is given previous to pulling. The seed has reached maturity when two thirds of the stalk are yellow.

PULLING. Flax requires careful pulling. Small handfuls are generally taken at a time, the stalks of which are laid two and two across each other to dry. They are afterwards gathered into larger bundles and the seed ends tied together so as to form sheaves.

[5] What are osiers? Twigs. (Illustrate by basket work.)

[6] These might be sketched on the blk. bd. to give a clearer idea of the arrangement.

IV. Preparation.

The flax is first steeped in water until the stems are partially rotten. This is done to cause the fibres of the bark to separate easily. It is then exposed to the sun and air for about a fortnight, after which the woody portion is separated from the fibrous part, by means of a peculiar instrument used for that purpose. The flax is then "*heckled.*" This consists in separating the short fibres from the longer ones: the former are not used. The flax is then ready for the mill, where it is spun by machinery.

V. Use.

For making linen goods. The manufacture is by no means extensively carried on in this country. The chief mills are those of Messrs. Marshall at Leeds.

Linen is made principally at Belfast,[7] in the sister kingdom of Ireland: hence the term "Irish," as applied to linen shirting.

[7] Shew on the map.

THE TEA PLANT.

MATTER.

I. Where found.

The tea plant is grown nearly all over China, where it is the object of very careful cultivation. It is also found wild in Assam.[1]

II. Description of the Plant.

(1) HEIGHT. 4 to 6 feet. In appearance it very much resembles a myrtle tree.

(2) LEAVES. From one to two inches in length. They have serrated edges[2] and are evergreen.

(3) BLOSSOMS. White: very like jasmine.

III. Cultivation and Gathering.

The seeds of the tea plant are sown in rows, 4 or 5 feet apart, great care being taken to keep the ground free from weeds.[3] When coming up, men water them frequently.[4] Two sets of men are employed in doing this—one brings the water in buckets, the other distributes it over the soil.

When the plant has reached the height of 3 or 4 feet, the leaves are gathered. This process commences in May or June, and is carried on three or four times a year. The first gathering is always the best. Great care is required in gathering them so that the leaves may not be bruised:[5] hence the gloved hand of the gatherer. Each leaf is picked separately and is placed in a basket provided for the purpose.

IV. Preparation.

After the leaves have been gathered they are exposed for a few hours to the air, and are then placed over a heated stove to dry. They are kept constantly stirred[6] by men whose duty it is to look to this department.

When properly roasted, the leaves are replaced in a basket and curled and rubbed by hand.[7] They are then placed again in the pan and roasted a second time, after which they are spread out upon a table and all imperfect leaves removed. The best teas are again rolled separately leaf by leaf. The last process is *the mixing*. Here great deception is practised,

METHOD.

Enquire of the children what is drunk at meals. At tea-time we drink **Tea.**

[1] Shew these countries.

[2] Notched edges. (Illus. by a saw or a rose-leaf.)

[3] Why? Because weeds choke the plants.

[4] Why? Because the climate is so hot. (Illus. by our gardens in summer.)

Picture out the Chinamen with their water buckets and peculiar dress.

[5] Why? Because the flavour would leave them.

[6] Why? To prevent burning. (Illus. by fryingpan.)

[7] Illus. by a boy with an ear of corn.

and an unnatural colour imparted to it by the Chinese,[8] who use paint for this purpose.

The following will explain the terms "Green" and "Black" Tea.

[8] Shew how this may be detected, viz., by moistening the leaf on the tongue.

GREEN TEA.

(1) The leaves are roasted almost immediately after they are gathered.

(2) They are dried off quickly after the rolling process.

BLACK TEA.

(1) The leaves are exposed to the air for some time.

(2) They are then tossed about till they become soft and flaccid.

(3) They are then roasted for a few minutes, and rolled, after which they are exposed to the air for a few hours in a moist state.

(4) Lastly, they are dried slowly over charcoal fires.

V. Qualities.

Tea is stimulating, and hence it is drunk extensively by those who wish to work at night, such as students, &c.

REMARKS. A Chinese tradition thus accounts for the discovery of tea: "A pious hermit in his watchings and prayers had often been overtaken by sleep so that his eyelids closed; in holy wrath against the weakness of the flesh, he cut them off and threw them on the ground. But a god caused a tea shrub to spring out of them, the leaves of which exhibited the form of an eyelid bordered with lashes, and possessed the gift of hindering sleep."

About 26 million pounds are imported to England annually. This gives considerably more than a pound to each person, on an average, during the year.

There are many different kinds of teas: more than one hundred among the Chinese. The principal of these varieties are

(1) Black Teas: Bohea, Congou, Souchong, and Pekoe.

(2) Green Teas: Hyson and Gunpowder.

N.B. The teacher may conclude the lesson by alluding to the history of the use of tea in England, thus:

Dried sage leaves had been much used before tea was brought from China. Whitfield, at Oxford, in 1730, frequently drank sage tea.

Two lbs. of tea were considered a rare gift to Charles II., by the East India Company, in 1664.

THE CACAO OR CHOCOLATE TREE.

MATTER.

I. Where found.

The cacoa tree grows wild in Brazil and the West Indian Islands. It is cultivated in many parts of South America, Africa, and Asia.[1]

II. Description of the Tree.

(*a*) HEIGHT. About that of a cherry-tree, 15 to 20 feet.[2]

(*b*) FLOWERS. Saffron colour:[3] have no scent.

(*c*) PODS. Succeed the flower. Each has five cells, containing oval seeds. Besides these pods there are others growing on the branches, each of which contains from 30 to 100 kernels. Very much resembling almonds.

III. Cultivation and Gathering.

The first business of the planters is to choose a suitable spot for the plantation. A level piece of ground, with rich black soil, and sheltered by a wood, is the best. The planter now proceeds to clear the ground of all stumps and weeds. He then digs a number of holes from 18 to 20 feet apart. Before planting, the best and largest seeds are selected, taken out of the pods and placed in a vessel of water. Those that swim are cast aside as useless, the others are washed clean from the pulp, and after being skinned, are allowed to remain in the water till they begin to sprout. They are then fit for planting. This is done as follows: the planter takes some of the leaves of the banana,[4] and places one of them in the circumference of each hole, so as to form a lining, leaving the leaf some inches above the ground, because it has to be wrapped over.[5] This done, he takes up a handful of soil and rubs it between his hands till the hole is filled. Three nuts are now selected for each hole and planted triangularly,[6] by making a hole for each nut about three inches deep. The nut is planted with that end downwards from which the sprout issues. The nuts are then covered with soil, and after folding the leaves over them a stone is placed upon them to prevent them from opening[7].

METHOD.

If we wish to change our beverage at breakfast-time, what can we have instead of tea or coffee? **Cocoa.**

[1] Refer to these on the map.

[2] Illus. by surrounding objects.

[3] A reddish yellow.

[4] A large tree growing in tropical climates.

[5] This operation might be accompanied by a diagram on the blk. bd.

[6] Explain by a diagram.

[7] Shew that the stone is not a heavy one, otherwise the shoots could not appear.

In about eight or ten days the young shoots begin to make their appearance. As soon as this is discovered, the banana leaves are unfolded, in order that the growth of the young plants may not be impeded.

As the plants grow, it is necessary to provide for them shelter from the sun. For this purpose other leaves or branches are placed round the holes, which are replaced as often as they decay. This goes on for five or six months. When the plants have attained the height of a few feet, bean-trees are planted to the south-west of each of them to protect them still further from the sun.

The cacao tree generally begins to repay the cultivator after five years, but does not gain perfection until it is eight years old. It generally produces two crops in a year, and frequently bears until 20 years old.

There are many hindrances to its growth, such as blight and drought. Frequently a whole plantation has been known to die in a single night without any visible cause.

When the fruit is ripe (this is the case when on being shaken the seeds inside rattle) it is gathered by hand: generally twice a year, in June and December.

IV. Preparation.

The method first adopted by the Spaniards[8] was very simple.

The ingredients used were cacao (the fruit of the tree), maize (a kind of corn), raw sugar, and a sort of juice called "roco." This last was added to impart a colour to the mixture. The whole was then ground between two stones, and mixed together in certain proportions until a kind of bread was made. This, when dissolved in water, formed an agreeable beverage.

In England, the beans or nuts are generally ground with the addition of sugar and vermicelli, which is the fruit of a plant growing in South America.

These ingredients are made into the cakes of chocolate which are so common in our shop windows.

[8] Why by Spaniards? Because they were the first to colonize South America.

V. Uses.

(1) Cocoa and chocolate form an agreeable beverage, imparting much more nutriment to the system than tea or coffee.

(2) The oil, which is expressed from the kernels, is used in the manufactures of soap and candles.

THE RICE PLANT.

MATTER.

I. Where found.

Rice plants are cultivated mostly in India and China, and to a certain extent, in South America, and Egypt along the banks of the Nile.[1]

Smaller quantities are produced in Italy, Spain, and South Carolina in North America.

II. Cultivation and Harvest.

The rice plant requires a very marshy soil. Frequently the lands upon which it is raised are entirely flooded. In some districts, where rain is scarce, the ground, destined to receive rice plants is artificially flooded.[2] After the water has subsided, a thick coating of slime is left upon the surface of the soil. In this rich deposit the young plants are placed.

Previously to being planted the rice cuttings are soaked in water and manure,[3] the effect of this is seen in the fact that in two or three days the young plants appear above ground.

As soon as they have attained the height of six or seven inches they are pulled up and the tops cut off.[4] After which the roots are carefully washed and the plants once more committed to the ground about one foot apart. Frequently during the growth of the plants they are sprinkled with lime water.[5] Great care is taken to remove weeds, so much so that we can form no idea of the laborious occupation which this task imposes.

In some countries the cultivation of rice is carried on differently. As soon as the rainy season sets in,[6] holes are made in the ground and seeds scattered in them. It often happens that a great proportion of the seed thus planted never takes root, because it is eaten by birds.

In order to prevent this, a number of wooden machines are so constructed in the rice plantation that a child, by pulling a string at one end, can set the whole apparatus in motion.[7]

METHOD.

Of what is a rice-pudding made? Rice. Yes, rice comes from the **Rice Plant.**

[1] Shew these countries on the map.

[2] Explain how.

[3] Why? To facilitate their growth. (Illustrate by steeping peas in warm water before planting them.)

[4] Why? To make them grow more bushy and to add to their productiveness. (Illus. by similar practices in this country, which may be elicited from the class.)

[5] To destroy insects (Compare our beans, &c.), and also to enrich the soil.

[6] Explain this term, which to an uneducated ear, seems strange.

[7] Analogous to this is our "clapper," used to scare the birds. Shew that it is not so effective.

There are two harvests in a year; the first is in May or June, the second in October or November. The reaper is furnished with a sickle, having a serrated edge.[8] When gathered in, the rice is threshed with a flail,[9] and the husks are removed by bruising the grain in a mortar.[10] The straw is burnt on the spot and thus serves to enrich the land. The grain is then sifted.

[8] Notched like a saw. Sketch one on blk. bd.

[9] Draw attention to this practice, shewing the amount of labour it entails.

[10] What is a mortar? (Refer to chemists who use them for mixing drugs.)

III. Uses.

The following are the uses to which rice is applied:—

(*a*) FOR MAKING BREAD. This soon gets dry and hard. It constitutes the chief food of Eastern nations. The Chinese pity Europeans, because they have not this extensive supply of rice. They eat it by using very dexterously two small skewers, called "chopsticks."

(*b*) PUDDINGS. Very nutritious; hence often given to invalids.

(*c*) STARCH. Makes a very good kind.

(*d*) RICE-PAPER. Very beautiful; but too delicate for ordinary purposes.

(*e*) STRAW. Used for making bonnets and hats.

REMARKS. "Formerly rice used to be brought into England with the husk removed; but, of late years, a manufactory has been established in London, for the purpose of cleaning the grain, and it is found that by being imported in the husk, it retains its flavour much better. In this state it is sometimes called by the Sumatran name of *paddee*. The value of rice as an article of food, can hardly be too highly estimated. In the East it is the chief dish of all orders of people, from the Sultan to the beggar."—*Saturday Magazine.*

Notice the providence of God in furnishing the inhabitants of tropical climates with the rice plant, which yields a food, not only more wholesome, but far cheaper than animal food, and, at the same time much more adapted to the requirements of the body.

THE CAOUTCHOUC TREE.

MATTER.

I. Where found.

The India-rubber tree is found principally on the banks of the Amazon and its tributaries; also in Hindostan, China, and the Islands around Sumatra.[1]

METHOD.

When you have made a wrong line with your lead pencil, how do you rub it out? **With India-rubber.** We will speak of the India-rubber tree.

[1] Shew on the map.

II. Description of the Tree.

Grows to a very great height; has a perfectly straight trunk, and all the branches at the top.[2] Those of Hindostan are sometimes 6 ft. in circumference.[3]

LEAVES. Well formed, smooth on *both* sides.

SEEDS. Three in number, contained in a pod with three cells, in each of which is a kernel. This kernel when peeled and boiled in water yields a thick oil or fat, which is used by the Indians as a substitute for butter.

GUM. Collected from the trunk, chiefly in the time of rain, because it is then most abundant.

III. Preparation of the Juice.

The India-rubber is the resin of the tree. In order to obtain it the Indians make several horizontal incisions in the bark at about a foot distance from each other. By degrees the gum oozes from these into cups prepared for it. It is then exposed for some time to the air, which gives it solidity. It is exported in the form of bottles[4] and other shapes.

IV. Qualities.

The gum when hardened is solid, elastic, waterproof, erasing, flexible, and tough.[5]

V. Uses.

(1) TO THE INDIANS.

(*a*) BOOTS. The Indians smoke them to give them the appearance of real leather.

(*b*) BOTTLES. Reeds are adjusted to their necks so that the liquor can be squeezed out. One of these is always filled with water and presented to each guest at an Indian entertainment.

(*c*) FLAMBEAUX. Made of the resin when liquid.[6] They give a brilliant light and but little smell.

(*d*) CLOTH. Made by the inhabitants of Quito.[7] Very much resembles our oil cloth.

(*e*) Various ornaments and small articles used as trinkets.

(2) TO US.

(*a*) OVERSHOES. Known as goloshes. Many hundreds of pairs imported annually to European countries. The shoes when made are covered with waterproof varnish.[8]

[2] Comp. cocoa-nut and date palms.

[3] Explain this, and in an upper class arrive at the diameter of the tree, by mensuration.

[4] Hence "bottle india-rubber." Explain this.

[5] Elicit the names of other substances possessing these qualities, which qualities should be drawn from the children.

[6] Explain how they are made; viz., tow twisted into a stick and soaked in the liquid. Also their use: as a torch on state processions.

[7] Shew on the map.

[8] Proof of this:—their shiny appearance and waterproof nature.

(*b*) ARTICLES REQUIRING ELASTICITY. *e.g.* Braces, elastic bands, tubes of various instruments, &c.

(*c*) SPRINGS OF VEHICLES. In this state it is known as vulcanized India-rubber.

(*d*) For erasing pencil marks.

THE MUSHROOM.

MATTER.

I. Where found.

Mushrooms are found plentifully, at certain seasons of the year, in most countries in the temperate zone.[1]

II. Description of the Mushroom.

Mushrooms are a species of fungi:[2] Toadstools, puff or fuzz-balls (so called from the powder they contain), and the champignon, are all of this class of vegetable. Some of them are poisonous; the mushroom and champignon are most generally eaten in England. Fungi differ from all other vegetable productions in having no leaves or flowers. On account of their offensive smell they are generally shunned. Yet they are not without some redeeming quality, for to this class belong some of the most beautiful colours in the vegetable world.

Some years ago it was thought that mushrooms spring from putrefied substances; lately, however, the seeds have been discovered, but they are very minute.

A mushroom consists of three parts:

(1) THE CAP. This is the part similar in shape to an inverted saucer.[3] In its early state it resembles a button. In substance it is firm and fleshy. The underpart of the cap is termed

(2) THE GILLS. They are generally pink, and retain their colour when the mushroom has reached maturity. The third part is

(3) THE STEM. This corresponds to the trunk of a tree.[4]

The gills of a toadstool are black, and emit an unpleasant odour. They are more flimsy and become almost fluid when pressed by the fingers.

METHOD.

What do children in the country often gather early in the morning in the meadows? "**Mushrooms.**"

[1] See that this limit is accurately understood by requiring the class to name countries so situated.

[2] Explain this class of vegetable, shewing that it is produced on trees, and in places where putrefaction has taken place.

[3] Explain "inverted." Sketch the former on the blk. bd.

[4] At this stage of the lesson the teacher may sketch a mushroom, when each part may be more readily explained and understood.

III. Uses.

Known to all. (1) To eat. (2) To make catsup.[5]

REMARKS. In distinguishing between mushrooms and unwholesome fungi, we may remember that the following are injurious :

(1) Those growing on the skirts of woods, or on decayed trees.

(2) Those having an unpleasant smell and hot taste.

(3) Those which, when broken, yield a milky juice.

Some persons, in boiling fungi, place a silver spoon in the saucepan, believing that if they are noxious the silver will be turned black. This is only a fair test when applied to *very* injurious ones.

[5] Here correct the common error in this word.

THE SUGAR CANE.

MATTER.

METHOD.

When we have poured out our tea, what do we put into it? **Milk.** Anything else? Sugar. Sugar comes from **The Sugar Cane.**

I. Where grown.

Most countries of the tropics, especially in India, China, the West Indies and Brazil.[1]

[1] Shew on the map.

II. Description of the Cane.

The sugar cane is a species of grass. It grows from seven to twenty feet in height[2] according to the nature of the soil. The canes have knotty rings caused by the falling off of the leaves when withered.[3] They are of a bright yellow colour, marked with red. The leaves are long, narrow, and serrated. Under them are downy blossoms of a lilac hue.

[2] Comp. with surrounding objects.

[3] Sketch the stalk on the blk. bd., and further illustrate by reference to a common cane.

III. Cultivation and Gathering.

Sugar canes are propagated from cuttings or shoots, which are generally about a yard long. They are planted in trenches, *horizontally*, so that, if the soil be productive there will be as many new stalks, as there were joints in the cutting.[4] As the canes grow they require support. This is afforded them by hoeing the soil around the base of each stalk.[5] Formerly this was done by hand, but of late years the plough

[4] Explain this and illustrate by a sketch on the blk. bd.

[5] Compare potatoe hoeing, &c.

has superseded manual labour. There are many hindrances to the growth of the canes; the principal of these are—

(1) THE BLAST. This is by far the worst. Myriads of small insects infest the cane, making their way to the centre in order to extract the juice, which is their food. It not unfrequently happens that the greater part of a plantation is thus destroyed.

(2) THE BORER. This, as its name implies, is a caterpillar which eats away the cane.

(3) RATS AND MICE. These are not so destructive as the other two, but still they do considerable damage.

When the canes are quite ripe they are cut close to the ground by negroes, provided with bill hooks.[6] After the canes are cut down the tops are taken off, cut into lengths and tied into bundles. They are then carted to the mill, where they are crushed between heavy rollers. This forms the first process in the manufacture of sugar.

The refuse leaves and stalks are gathered into heaps, each about 20 feet from the others, and left upon the land to rot and act as manure.

[6] What is a bill-hook? Refer to the process of *hedging* when bill-hooks are employed.

IV. Uses.

(1) For sweetening our food and making sweets.[7]

(2) The tops, which are of no use, because too green, are given as fodder to the cattle.

(3) From the dregs, or molasses, treacle is obtained.

N.B. The annual average consumption in England, for each person, is about 28 lbs.

[7] Elicit from the class barley-sugar and sugar-candy.

N.B. The teacher may briefly allude to the fact that we obtain sugar from the beet-root and also the maple tree: the former grows in France, Germany, and other countries of central Europe; the latter in the forests of North America.

THE COFFEE TREE.

MATTER.

I. Where grown.

Coffee is produced in various parts of the Old and New Worlds. It is wild in Abyssinia, but is cultivated in West Indies, Brazil, Central America, Java, Arabia, and Ceylon.[1] Our supply is obtained chiefly from Arabia and the West Indies.

II. Description of the tree.

(*a*) HEIGHT. From 8 to 12 feet.[2]

METHOD.

Let the teacher introduce the lesson by exhibiting a few coffee berries.

[1] Shew on the map of the world.

[2] Comp. with objects near.

(*b*) BRANCHES. Slender, bent downwards; have evergreen leaves similar to those of the bay tree.

(*c*) BLOSSOMS. White: very much resemble those of the jasmine[3].

(*d*) FRUIT. Is a red berry, resembling a cherry; has a pale, insipid, and rather glutinous pulp.[4] This skin contains two hard, oval seeds, each about the size of a pea.[5]

III. Cultivation, Gathering, and Preparation.

The coffee tree may be propagated by either seeds or young plants. It thrives best upon the sides of sloping hills. The seeds are planted from 6 to 12 inches apart, and, if possible, are so distributed as to be sheltered by larger trees when growing.

Great care is exercised during the growth of the plant, both in order to keep it well watered and also free from weeds.

The gathering commences in May, and this crop consists of the finest berries. They are carefully obtained by shaking the trees gently, when the fruit falls on a cloth spread beneath for the purpose of receiving it. The berries are afterwards spread upon mats and exposed to the sun till perfectly dry; after which the husk is broken by heavy stone rollers. The berries are then dried again by roasting them over a fire in a cylindrical vessel, which is kept revolving,[6] after which they are ground for use.

IV. Use.

Well known to all: an agreeable and stimulating drink.

REMARKS. Coffee was introduced into Arabia from Persia, by the Governor of Aden, who had recourse to it medicinally. It was not, however, till 1554, that coffee was sold at Constantinople, and the first coffee houses established in London date from 1652.

About 50 millions of pounds are consumed annually.

It is said that the stimulating nature of coffee was first discovered as follows:—The Father of a monastery observing how frisky and playful goats became after browsing upon coffee berries, administered a decoction to his monks to keep them awake during their devotions.

Avoid chicory if you can buy a sufficient quantity of coffee. Its presence in coffee may

[3] Enquire if any children have seen jasmine.

[4] Explain "insipid," and "glutinous."

[5] Exhibit two shewing how they fit, the flat sides being next each other.

[6] Explain "cylindrical" and illus. by a gaspipe. Also shew why it is kept revolving; so that no berries may be burnt and so spoiled.

be easily detected by putting the mixture into *cold* water, when the chicory, at once, sinks.

"It is curious to notice how the practice of adulteration extends itself from trade to trade. The coffee dealer adulterates his coffee with chicory to increase his profits; the chicory maker adulterates his chicory with Venetian red to please the eye of the coffee dealer: lastly, the Venetian red manufacturer grinds up his colour with brickdust, that, by his greater cheapness and the variety of shades he offers, he may secure the patronage of the traders in chicory." —*Johnston's Chemistry of Common Life.*

THE CORK TREE.

MATTER.

I. Where found.

Cork trees are very abundant in the South of Europe (Spain, Italy, Southern France), and the North of Africa (Algeria and Barbary).[1]

II. Description of the tree.

There are two varieties of the cork tree; broad and narrow-leaved: the former produces the best cork.

(*a*) HEIGHT. Upwards of 30 feet: many of the broad-leaved species reach 40 feet.[2]

(*b*) LEAVES. Bright green; oval shaped;[3] indented or serrated edges;[4] smooth on the upper side, downy on the under. They grow alternately on the branches,[5] which are rough and strong. In general appearance the cork tree very much resembles the English oak.

(*c*) ACORNS. Long and smooth, about the size of our oak acorns: indeed they so much resemble them, that when the two are mixed, it is difficult to distinguish between them. They are brown when ripe.

III. Preparation of the bark.

The best cork is obtained from the oldest trees:[6] they are generally barked about their fifteenth year, and at intervals of ten years afterwards. This allows ample time for the formation of a new coating of bark.

METHOD.

When we have filled a bottle, what do we put in the neck to prevent its contents from escaping? **A Cork.** Cork comes from **The Cork Tree.**

[1] Shew on the map.

[2] Comp. with objects near.

[3] Comp. with egg: in an upper class give the derivation, "ovum"—an egg.

[4] Saw-like. Illus. by those of a rose-tree.

[5] Shew how by a sketch on the blk bd.

[6] Why? Because young ones are too porous. Illus. by a sponge: a piece of cane.

It is gathered as follows: Perpendicular and horizontal incisions are made in the bark by means of a peculiarly-shaped knife, made for the purpose. Sometimes the bark is allowed to fall off, at others it is peeled off, soaked in water, scorched,[7] in order to make it more impervious to moisture; then dried, packed in bales, and exported.

[7] What shews this? Its charred appearance.

IV. Qualities.

Cork is buoyant, light, waterproof, yielding, elastic, and apparently porous.[8]

[8] The "Uses" should be shewn as the result of these qualities.

Not *really* porous because there is no communication between the pores.

Ask for other substances possessing any of these qualities.

V. Uses.

CORKS. For stopping vessels; making soles for shoes. The ancient Egyptians lined their coffins with cork.

Bottles came into use about 15th century, and until cork was known, clay and pitch were used as substitutes.

LIFE BOATS, &c. Sides are lined with cork, and the seats filled with it. Belts and jackets as aids[9] to the preservation of life from drowning, are also made of cork. Floats, for fishing lines, are also made of this material.

[9] Refer to circular belts as aids in learning to swim.

THE COTTON PLANT.

MATTER.

METHOD.

I. Locality of production.

When your mothers sew, what do they use besides a needle? **Cotton.** Cotton comes from **The Cotton Tree.**

Grows wild in Asia, Africa, and America, but it is also much cultivated in these continents: Asia,—in Further India, Egypt, China, and India. Africa—in the neighbourhood of the Senegal and Niger.

America. United States, Mexico, W. Indies. The best kind is produced in Carolina and Georgia (two of the United States), and is called "Sea Island Cotton," from the fact of its being grown on sandy districts near the coast.[1]

Shew all these upon a map of the World.

A little cotton is also grown in the South of Europe. All varieties of cotton require a dry, sandy soil; in fact, cotton will thrive where the soil is too poor to produce any other crop. Too much wet destroys the harvest, yet it is fond of a maritime situation, because the salt water and mud from the marshes, are a great help to its growth.

II. Description of the plant.

General appearance, very similar to the hollyhock: many species very large.

(*a*) HEIGHT. From 2 to 3 feet.[2]

(*b*) LEAVES. Dark green: in shape similar to those of the sycamore tree.[3]

(*c*) FLOWERS. Pale yellow, purple in the centre: in shape somewhat similar to those of the hollyhock.

(*d*) FRUIT. Three-celled and containing a number of seeds. Having grown to the size of a large walnut, it bursts and discloses a soft, white, fibrous material; this is "cotton."

[2] Comp. with objects near, in order to give an idea of its height.

[3] Sketch one on the blk. bd.

III. Propagation, Gathering, &c.

Previous to planting, the land is ploughed into ridges, five feet apart, and in drills;[4] along the tops of these the seeds are sown. Soon after the seeds appear above ground, they are transplanted so as to leave the healthiest and strongest room to grow. They are repeatedly hoed and weeded. This affords not only nourishment, but also support against the violent winds and rains of tropical climates.

[4] Explain "ridges" and "drills," and illus. by a sketch on blk. bd.

The cotton plant meets with a great hindrance to its growth in a destructive caterpillar, which eats into the heart of the plant. It not unfrequently happens that a whole crop is destroyed by the ravages of these worms. Hence great numbers of people are employed to extirpate them.

The harvest is gathered in about five or six months from the time of planting. In some districts the pod is gathered with the cotton. But the husk is brittle, and fragments breaking off and mixing with the raw cotton render it difficult to clean. People are often employed to extract the seeds and cotton. To do this they wait till the pods open, and inasmuch as some pods are later in opening than others, the harvest takes several weeks. The harvest is carried on principally in the mornings, because if left till noon the sun would discolour the cotton. It must be gathered too in *dry* weather, for damp would turn it mouldy and so spoil it.[5] Each gatherer carries a bag slung round his neck, in which he places the cotton. When the harvest is over and the cotton cleaned, it is packed in bales and subjected to heavy pressure.[6] It is then exported to the various seats of its manufacture.

[5] Illus by reference to preserves, &c.

[6] Why? So as to export a greater quantity at a time.

Explain a "bale," and illus. by drapers' packages.

N.B. The cotton manufacture might be chosen as a fitting supplement to this lesson.

PART III.—THE MINERAL KINGDOM.

GOLD.

MATTER.

I. Where found.

Gold, which is one of the precious metals,[1] is found in small quantities in Europe, in some rivers of Africa, and in lumps, called "nuggets," in Australia and California.[2]

It is obtained from rivers by washing away the sand with which it is found mixed, and from the nugget, by crushing the ore[3] with heavy machines. The districts whence these nuggets are obtained are called the "gold diggings."

II. Qualities.

Gold is fusible, malleable, ductile, soft, heavy, and it does not rust.[4]

III. Uses.

(*a*) FOR COINS. On account of the softness of gold, it is alloyed by mixing with it copper and silver.

Standard gold, i.e., gold of which our coins are made, consists of 22 parts of pure gold to 2 of alloy. The price of this gold is fixed by Government at £3 17s. 10½d. per oz. One pound will weigh as much as will coin 46 sovereigns.[5]

(*b*) FOR ORNAMENTS OF VARIOUS KINDS. Every piece of gold is supposed to be divided into 24 parts, called "carats," and the purity of a gold ornament is reckoned according to the number of carats of gold it contains.

Jeweller's gold is not so pure as that used for coins. It generally contains from 16 to 20 parts of pure metal.[6]

(*c*) FOR GILDING PURPOSES. The gold used for this purpose[7] is called "gold-leaf," because it consists of very thin sheets of gold; in fact, the metal is so beaten by machinery that 200,000 sheets placed one upon the other would not be more than an inch thick.

REMARKS. Gold is nineteen times heavier than water. It is the heaviest metal with the exception of platinum.

METHOD.

Of what are sove reigns made? **Gold.**

[1] What is the other. Silver.

[2] Shew on the map.

[3] i.e., the metal and the dross with which it is impregnated.

[4] Let these be given, as far as possible, by the class, and require them to mention other metals having the same qualities.

[5] In an upper class the weight of a sovereign might be ascertained.

[6] Here ask the children to name any ornaments made of gold.

[7] Ask the class to tell the names of any thing thus covered with gold. They will, in all probability, answer picture frames, backs of books, letters over shop windows, &c.

IRON.

MATTER.

I. Where found.

Iron is by far the commonest, as it is also the most useful metal. It is found "in leaves, fruits, stalks, stems, flowers, in the soil we tread, and in many minerals, in the flesh and blood of men and animals, even in milk and water." The most extensive mines are those of Great Britain, Sweden, Elba, Belgium, France, and the United States[1]. Of these the principal are the three first :

(*a*) ENGLISH MINES. Have been wrought since the time of the Romans (The Forest of Dean iron works[2] were established by them). The peculiarities of English mines are their proximity to the coal mines,[3] also to limestone rocks ;[4] they generally contain some other metal, as copper or silver : they seem inexhaustible.[5]

(*b*) SWEDISH MINES. Have long been celebrated. The most noted are those of Dannemora, in which from 1200 to 1500 men are employed. These mines are famous for their purity, and the workmen and visitors descend into them by means of tubs attached to chains which work over pulleys.[6] These mines supply Sheffield.

(*c*) ELBA MINES. Are said to be the richest in the world. The principal mine is in the Rio Mount, which is 500 feet high, and three miles in circumference. The iron in Elba is supposed to extend to the adjacent mainland (Italy.)[7]

II. Process of Smelting.

The ore is first crushed into pieces, each about the size of an egg. It is then conveyed to the blast furnaces,[8] which are open at the top and closed at the bottom, the air being conveyed to them through piping Here it is reduced to a fluid and sinks, while the dross rising to the surface is skimmed off. Every now and then the liquid metal is allowed to run out into channels made in the sand adjacent to the furnaces. These masses are called "cast" or pig iron.[9]

In order to render them fit for better class goods, they are re-heated, melted, drawn out,

METHOD.

Of what are grates made? **Iron.**

[1] Shew these on the map of the world.

[2] Where are these? In Gloucestershire.

[3] Hence it can be worked cheaper. This is not so in France: show the consequence.

[4] Without this it could not be smelted.

[5] Those of South Wales alone would last, at the present rate of consumption, 2000 years.

[6] Sketch a diagram on the black board.

[7] Refer to the map.

[8] Describe the appearance of a number of these on a dark night. Illus. by reference to Wolverhampton in the heart of "the black country."

[9] From its unwieldly shape.

and hammered repeatedly. This process is termed "puddling," and the men engaged in it "puddlers."[10] The iron thus tempered is called "wrought iron."

[10] Shew what a laborious occupation it is, and illus. by the fact that puddlers are, generally speaking, short-lived.

III. Qualities.

Iron is hard, malleable, fusible, heavy, brittle, opaque, and ductile.[11]

[11] Explain these (in an upper class derive those which will admit of it), and ask for other substances possessing any of these qualities.

IV. Localities of Manufacture.

The principal of these are South Wales (Merthyr Tydvil): South Staffordshire (The Black Country): Shropshire (Coalbrookdale): Yorkshire; and in Scotland, the Carron Iron Works, near Stirling.[12]

[12] Shew on the map.

Upwards of 300,000 persons are employed in the manufacture of iron goods.

Rouen (France), Liege (Belgium), and Graatz (Austria), are also extensively engaged in this manufacture.

Uses.[13]

[13] Ask for various articles under each of these heads; *e.g.*, in machinery might be given; wheels, beams, girders, tubes, &c.: in household utensils; grates, stoves, saucepans, &c.

1. All sorts of machinery.
2. All sorts of household utensils.
3. All sorts of implements of war.
4. All sorts of agricultural tools.
5. Greatly employed in architecture of late years: *e.g.*, bridges, churches, &c.
6. Manufactured into steel, and thence into "cutlery."
7. Used medicinally. Chalybeate waters (from *Chalups* Gr.=steel) often taken for certain complaints. These springs are found principally at Tunbridge Wells, Harrowgate, Holywell, and Cheltenham.[14]

[14] Shew on the map.

SILVER.

MATTER.

I. Where found.

Silver is widely diffused. It is found in all parts of the world, excepting Australia.

IN EUROPE in our copper mines of Cornwall and lead mines of Cumberland; in Hungary (Schemnitz, the principal town), Spain, and Russia.

IN ASIA. Siberia, Japan, and some parts of Further India.

METHOD.

Of what are shillings, sixpences, fourpenees, &c., made? **Silver.**

IN AMERICA. Especially in Mexico, Bolivia,[1] Chili, and Peru. It was in this latter country that the metal was first discovered, in the Mountain of Potosi. It happened as follows:—An Indian named Huapla, was climbing the mountain in search of wild animals, when, in order to prevent himself from slipping, he grasped a small bush which came up by the roots. Sticking to the roots, silver was discovered, and, on further examination, a rich mine was found. This mine, which is in the Andes, is of a conical shape, 18 miles in circumference. The silver lies near the surface, hence there is less difficulty in obtaining it. The silver is conveyed from the mine to the sea by means of llamas.

[1] Shew on the map.

II. Qualities.

Silver is ductile, fusible, malleable, hard, sonorous, reflective.[2]

[2] Ask for the names of other substances possessing these qualities and explain them, giving, in an upper class, where the word admits of it, the derivation.

III. Uses.

(*a*) FOR COINS. All civilized countries now use silver coins. As in the case of gold, silver is alloyed: out of 12 parts, $11\frac{1}{10}$ are silver, and $\frac{9}{10}$ copper.

(*b*) FOR PLATE, which term includes spoons, forks, and various vessels used at the table. Silver is well suited for this purpose, inasmuch as it is not affected by acids used in our food.

(*c*) PLATED GOODS. These are articles made of commoner metals and covered with a coating of silver, and are generally purchased by those who cannot afford the genuine article Silver is prepared for plating as follows: a layer[3] of silver is placed upon a layer of copper. Both are then heated and flattened by steel rollers of tremendous power, into sheets the thickness of writing paper. This coating is spread over the articles, which are then beaten with a steel hammer and polished.

[3] Illus. a layer by slices of bread and butter.

(*d*) LUNAR CAUSTIC. This is a chemical preparation of silver used by surgeons. When dissolved it forms

(*e*) MARKING INK.

REMARKS. Silver was formerly so abundant in Mexico that the churches were most of them furnished with costly images made of it.

The Rio de la Plata was considered specially rich in this metal, hence its name:[4] also the Argentine Republic.[5]

[4] Explain this.

[5] From "Argentum" (L.)=silver.

TIN.

MATTER.

I. Where found.

Tin is found principally in Cornwall,[1] and in smaller quantities in some parts of Asia and America.

The mines of Cornwall have been worked ever since the time of the Romans, for we read of the Phœnicians trading thither for tin more than 2000 years ago: indeed the islands now known as the Scilly Islands, were then called "Cassiterides," a word meaning "Tin Islands."

The productiveness of these mines may be seen from the fact that they produce $\frac{1}{2}$ of the tin raised in the whole world.

II. Qualities.[2]

Tin is

(*a*) Fusible. It is more easily melted than any of the metals.

(*b*) Ductile, though not so much so as gold.

(*c*) Malleable. It may be hammered until a sheet of tinfoil will not be more $\frac{1}{1000}$ part of an inch thick.

III. How obtained.

Tin is obtained from mines.[3] As soon as the miners discover a spot containing it, they sink a shaft.[4] It is generally found in veins or layers. The ore is split by the action of gunpowder,[5] as is also the case in rock-salt mines. The blocks of ore are hoisted to the surface by means of a capstan[6], turned by horses attached to long poles. After the ore has been crushed, it is placed in a furnace, together with charcoal and a little lime. Here it soon melts, and the dross rising to the surface is skimmed off, leaving the pure metal at the bottom. This is called "*refining*."

IV. Uses.

(*a*) As a coating for iron and copper vessels[7]

(*b*) Pins are whitened by boiling them in tin.

(*c*) Looking glasses are silvered by means of tin mixed with mercury.

(*d*) Various articles, such as cans, saucepans, &c., are made of tin plate.

METHOD.

You have all seen milk cans: of what are they made? **Tin.**

[1] Shew on the map.

[2] Require the children to name other substances possessing these qualities. This will shew that they understand the meanings of the words they use.

[3] Ask for other metals or minerals thus obtained.

[4] i.e., an opening in the earth extending some distance below the surface. (Illus. by a deep well.)

[5] Explain the "blasting," shewing the dangers to which the miners are exposed.

[6] Illus. by the working of a capstan, by reference to one on board a vessel.

[7] Ask for some, and shew the injurious effects arising from copper saucepans being used in cooking.

COAL.

MATTER.

I. Where found.

Coal is found in various parts of the world, especially in North America and our own country. Tracts of land, from which coal is obtained, are called "coal fields." They are situated in three different parts of England: The North, the Centre, and the West.

The Northern district includes the six Northern counties.[1]

The Central district embraces Worcestershire, Derbyshire, Lancashire, Stafford, and Shropshire.

The Western comprises South Wales and Gloucestershire.[2]

II. How obtained.

Coal is obtained from mines, hence it is termed a mineral.[3] The men who work in these mines are called "miners." In seeking for coal a hole is first bored in the ground with iron tools. If coal is thus discovered, a shaft is next sunk, having a diameter of 8 or 10 feet, and lined with brick work or iron to prevent the sides falling in.[4] Having arrived at a bed of coal, the miners proceed to excavate,[5] the chief tool used being a pickaxe.[6] In this way they form long passages to the right and left of the shaft, and when they wish to dislodge a considerable portion at once they have recourse to *blasting*. This is done as follows: Having first bored a hole some distance into the rock, they insert a quantity of gunpowder, and then, by means of a light fastened to the end of a long iron rod,[7] they ignite it.

Blocks of coal, weighing several tons, are in this way detached, which would take days, by manual labour, to remove.

When a sufficient quantity of coal is obtained, it is taken in iron tubs, along tramways,[8] to the mouth of the shaft, when it is hoisted to the surface by the aid of powerful machinery.

Each coal mine is generally provided with two shafts, so that a perfect current of fresh air may be maintained. In addition to these there are several pipes communicating with the interior of the pit, both for the admission of pure

METHOD.

What is that black substance which we burn? **Coal.**

[1] Ask for their names.

[2] The teacher should have the map at hand so that these places may be more firmly impressed upon the minds of the class.

[3] Are all substances dug out of mines called minerals? Having obtained the answer to this question, explain the difference between a mineral and a metal. The children will, no doubt, be able to give a few peculiarities of each.

[4] Explain this and illus. by diagrams on blk. bd. and by reference to well-sinking.

[5] i.e., "to hollow out." (In an upper class derive the word.)

[6] What is a pickaxe? Ask the children if they have ever seen one: they will most likely think of the operations of the roadmen.

[7] Why a *long* iron rod? To ensure the safety of the workmen.

[8] What are tramways? Why so called? From a Mr. Outram, who invented them to facilitate the transit of coal in the neighbourhood of Newcastle.

air, and also for the discharge of that which is foul.

III. Dangers to which Miners are exposed.

(1) EXPLOSIONS are not uncommon. These are frequently caused by the foul air coming in contact with the lamp of the miner. To avoid this, as far as possible, each man is provided with a safety lamp,[9] in which the lamp is enclosed in a wire gauze, to prevent the air communicating with the flame.

(2) CHOKE DAMP. This is a kind of gas generated by the explosions just referred to. In many cases men have escaped the former, but have been overtaken by the latter and suffocated.

(3) DROWNING. Large quantities of water sometimes burst into the mines, and, as the miners are continually coming upon fresh springs, great care must be taken to pump out the water as fast as it accumulates. Hence every pit is provided with powerful steam-engines for this purpose.

[9] Invented by Sir Humphrey Davy, and hence called "The Davy Lamp." Explain its principle and if possible illus. by a piece of gauze applied to a flame.

IV. Qualities.

Coal is opaque, black, brittle, inflammable.[10]

[10] Ask for other substances possessing these qualities.

V. Varieties of Coal.

(*a*) COMMON COAL. Contains a great quantity of bitumen.[11] This cakes very much when burnt; leaves many cinders, and much ash.

(*b*) CANNEL COAL. Burns with a very bright flame, and does not soil the fingers.

(*c*) ANTHRACITE COAL. Will scarcely burn in the open air; gives out no flame; neither leaves cinders.

Coal is generally named from the locality producing it, thus we have Derby, Wall's End. (This is a Newcastle coal, the name, "Wall's End," being given it, because it is obtained from the neighbourhood of an old Roman wall, constructed across the country, from the Tyne to the Solway Firth, in order to prevent the incursions of the Picts and Scots.) Leicester, Forest (Gloucestershire coal, so called because it is found in the Forest of Dean).[12]

Newcastle coal is often called "sea-coal," because it is generally taken to London by means of barges.

[11] What is bitumen? A pitchy substance.

[12] Refer to these districts on the map.

VI. Uses.

(*a*) AS FUEL FOR FIRES. We need fires, not only to warm us, but also to enable us to man-

ufacture our various kinds of goods. Indeed our manufactures depend in a great measure upon our supply of coal.

As our manufactures are carried on upon our extensive coal-fields, we can afford to sell the articles thus manufactured at a cheaper rate.[13]

[13] Shew how.

(*b*) IN MAKING GAS. The coal is heated in air-tight vessels, termed "*retorts*," out of which the gas is driven. In connection with this process coke is formed, and also

(*c*) GAS TAR, which is useful for preserving woodwork from decay.

(*d*) PARAFFIN OIL is also obtained from coal.

REMARKS. Coals are the remains of forests, which have been swallowed up by the earth. Time has changed the vegetable matter into stone, or in other words, has petrified it.[14]

[14] What proof have we of this fact? It very frequently happens that the shapes of leaves, twigs, &c., of bushes, may be discovered in the grain of a piece of coal.

Every year it is supposed that in England between 30 and 40 millions of tons of coal are raised, and so abundant is our supply, that, at the present rate of consumption, our coal fields would, in all probability, last many hundreds of years.

SALT.

MATTER.

I. Where found.

Salt is found in various parts of the world, especially in Gallicia (part of Austria), Poland, and our own country. The towns in England, famous for the production and manufacture of salt, are Droitwich and Northwich.[1]

[1] Shew all these places on the map.

II. How obtained.

Salt is obtained in three ways:

(*a*) FROM BRINE SPRINGS. These are mostly in the neighbourhood of Droitwich, in Worcestershire.

(*b*) FROM THE SEA.

(*c*) FROM MINES. Mostly in the neighbourhood of Northwich.

a and *b* furnish salt by means of evaporation. The water is placed in shallow vessels and exposed to the action of the sun and air. This process is extensively carried on at a town in Scotland, named Preston-pans, so called on account of the salt-pans, commonly used in connection with this manufacture.

METHOD.

When we eat our dinner, what do we frequently sprinkle over it? **Salt.**

Salt mines are worked similarly to those of coal, large natural pillars being left here and there, to support the roof.[2]

III. Qualities.[3]

Salt is

(*a*) COLOURLESS
(*b*) TRANSPARENT } only in a pure state.
(*c*) BRITTLE. Very easily broken.
(*d*) FUSIBLE. At a very great heat.

IV. Uses.

(*a*) To render food palatable.

(*b*) As food for cattle. They will often undertake long journeys in order to drink at a brine spring.

(*c*) For preserving and curing meat.

(*d*) As a manure. When applied to certain soils it is very serviceable.

(*e*) In Africa and Arabia slabs of salt are used as building stone.

(*f*) As a medicine.[4]

REMARKS.

(1) Salt is very cheap in this country. In some countries, however, it is very dear, so that for a man to eat salt is equivalent to stating that he is rich.

(2) In Eastern countries guests are placed at table according to the position of the salt cellar: those of the first rank sitting *above* the salt, while those of inferior station take their places *below* it.

(3) At Wieliczka, in Poland, there is a famous salt mine from which salt is obtained fit for table use. This mine is upwards of a mile long, and half a mile broad, and forms a sort of underground town, containing streets, churches, and statues all cut out of salt.

The effect produced by illuminating this mine is very imposing.

[2] The process of blasting, &c., may be briefly referred to. This portion of the subject need not be fully dwelt upon, as mining operations have been already explained in the lesson on coal.

[3] The teacher should have a piece of rock salt, and obtain its qualities from the class, as far as possible.

[4] Allude to "Epsom and Glauber's" salts.

LEAD.

MATTER.

I. Where found.

Lead is obtained from mines, which are found in many parts of our own country. The following counties contain considerable quantities of it.

METHOD.

Of what are the pipes of our cisterns made? **Lead.**

Derbyshire, Northumberland, Yorkshire, Cornwall, and Wales.[1]

When found it is not in a pure state, but is mixed with other substances, which must be extracted from it. In this condition it is termed "*lead ore.*"[2]

II. Qualities.[3]

Lead is of a bluish-grey colour, fusible, flexible, malleable, and ductile.

III. Uses.

(*a*) FOR SHEET LEAD. This is employed in various ways, such as roofing houses, making gutters, rain-water pipes, and lining cisterns. It is made into very thin sheets by the Chinese, who employ for lining their tea-chests.

(*b*) FOR BULLETS AND SHOT. Their shape is given them by means of moulds, into which the liquid metal is poured and allowed to cool. The buildings where shots are made are called "shot factories." They are generally situated on the banks of a river, and are in the form of a tower. From the summit of this tower the liquid lead is poured through a colander, and the drops then fall into water.[4]

(*c*) FOR PRINTING TYPES. Antimony is mixed with the lead in this case, to give it hardness and durability.

REMARKS. Lead must not be confounded with "black lead," which is a distinct substance.

The Romans called lead "*plumbum*," hence our words, "plumber, plumbing," &c.

[1] Shew these on the map.

[2] In order to ascertain if this lesson is understood, refer to tin and iron.

[3] Let these, as far as possible, be furnished by the class. This will call forth their thinking powers.

Compare the words "malleable" and "metal," and hence impress the meaning of the former more forcibly upon the class.

Shew also (if the lesson be intended for an upper class) that the "able" of "malleable" is changed into "ible" in "fusible" and "flexible;" but that both terminations convey the same idea.

[4] This gives them their circular shape. (Illus. by reference to a tear or rain drops, and in the case of a higher class, to the force of gravitation).

SLATE.

MATTER.

I. Where found.

Slate is found in many parts of Europe and in some districts of North America. Italy, Switzerland, Saxony, and France, are the principal European countries whence it is obtained.

Cornwall, Devon, Cumberland, and Westmoreland, in our own country, produce it in considerable quantities. It is also found in North Wales.[1]

II. How obtained.

Slate is obtained by quarrying. The upper strata of the ground are dug away until the

METHOD.

What do you work your sums upon? **Slates.**

[1] Shew all these places on the map.

slate is met with.[2] There are only two instances, in England, in which slate is worked as coal, i.e., by sinking a shaft.

[2] Explain this and illus. by stone quarries.

III. Description of Slate Quarries.

At Charleville, in France, there is a bed of slate, about 60 feet thick. The quarry is situated on the summit of a hill and has been worked to a depth of 400 feet, and 200 feet on either side. The whole quarry is full of lateral galleries,[3] and the descent is effected by means of 26 ladders. The slate is cut into blocks, about 2 cwt. each, called "faix." These are conveyed to the surface by machinery, where they are split into blocks called "repartons." The workman holds the block between his legs and, by application of his chisel, together with a blow of his hammer, splits it into writing and roofing slates.

[3] From "latus" = a side. Sketch a diagram on the blk. bd.

All this must be done soon after the slate is extracted from the quarry, otherwise it would not split.[4]

[4] Why not? Because it would be too dry.

The most important slate quarry in England is that of Hourston Crag, near Buttermere lake in Cumberland. This mountain attains a perpendicular height of 2000 feet. It is very difficult of access, hence the workmen take their provisions for a whole week, and sleep in temporary huts on the summit. In winter it often happens that they are involved in clouds and blocked up with snow.

After the slate is obtained it is conveyed down a zigzag path[5] on sledges, one man attending to prevent too great an accumulation of speed.[6] The sledge being emptied at the foot of the hill, the man carries it back on his shoulders to the top. But the slates are as yet in a rough state and must be made smooth. This is done by frequent grinding.

[5] Illus. by a diagram on blk. board.

[6] Explain and illus. by a loaded waggon descending a hill.

Those intended for writing are also enclosed in frames.[7]

[7] Why? For two reasons:
(*a*) It prevents the slate from being so readily broken, and
(*b*) The writing on them does not get rubbed off so easily.

IV. Uses.

(1) FOR ROOFING HOUSES. The tool used for this purpose is termed a "*zax*," and has a sharp point at the back for making the nail holes. The slates are placed overlapping each other.[8]

[8] Why? So that they may effectually keep out all rain.

(2) FOR WRITING SLATES. They are ground often and made smooth by the application of sand.

(3) SAWN SLATE has also come into use of late years, for cisterns, baths, and chimney-pieces.

CHALK.

MATTER.

I. Where found.

Chalk is very abundant in our own country, especially in Kent[1] and Hampshire. It is also common in many parts of Europe, but is very little known in North America.

II. Qualities.[2]

Chalk is (1) opaque, (2) white, (3) crumbling, (4) infusible.

III. Uses.

(1) The coarser kinds of chalk are burned into lime.[3]

(2) When reduced to powder, and the grit extracted, it is termed "whiting."[4]

(3) The large blocks frequently found in Hampshire are employed as building stone, but they are not very durable.[5]

(4) Chalk is also used medicinally; chalk mixtures being employed in cases of diarrhœa.

(5) To write with on the black board.

REMARK. Chalk, lying near the surface, is obtained by quarrying.

METHOD.

Let the teacher hold a lump of chalk in his hand. Then asking the question, "What is this?" he will be answered "**Chalk.**"

[1] Shew on the map and refer to the landing of Cæsar, near Dover, and to the name "Albion," which this country received on account of the white chalk cliffs which he saw on crossing the channel.

[2] As far as possible let these be given by the class; the teacher to call upon them to name other substances possessing the same qualities.

[3] For what is lime used?

[4] How is whiting employed?

[5] Why? Because too soft.

PART IV.—MISCELLANEOUS.

A LEAD PENCIL.

MATTER.

I. Description.

A lead pencil is composed of two parts:—(1) Black lead. (2) Wood.

(1) BLACK LEAD. Also called plumbago. It is obtained chiefly from Borrowdale, in Cumberland.[1] This is the only place where it is found pure. The mine furnishes it in such abundance that the proprietor opens it only for a short time in the year, in order that the price may be kept up.

METHOD.

What do we use to write with upon paper besides pens and ink? **Lead pencils.**

[1] Shew on the map.

Black lead is dug out in small lumps; it is black and shining, and is therefore employed as a polish for grates.

It is not in reality lead, inasmuch as it is neither malleable, fusible, nor ductile.[2]

(2) WOOD. Cedar wood is generally employed. It is obtained from the mountains of Lebanon.[3] Cedar trees are tall, like the fir, and, at one time, when they were more plentiful, were used for masts of ships and the rafters of houses. Old trees are distinguished by the barrenness of their trunks; the foliage and small branches being only at the top, and also by a number of trunks growing from one base.

[2] Dwell upon these and explain the differences between plumbago and lead.

[3] Shew on the map and refer to the use of cedar wood in the building of the temple.

II. Manufacture of the Pencil.

(1) The wood is sawn into narrow strips by a circular saw, each strip being the length of three pencils.[4]

(2) With another saw a groove is made along the middle of each strip, but some parts (where lead is not required) are without grooves.[5]

(3) The lead is prepared by being sawn into strips by a circular saw, each strip the same size as the groove into which it is to be fitted.

(4) Boys now place the lead in the grooves.

(5) A strip of wood is then glued over the lead.[6]

(6) The pencils are next rounded.

(7) They are then divided into three, and are fit for use.

[4] "Circular" (round). Draw a line on the blk. bd. to shew the length of a strip.

[5] This might be rendered clear by exhibiting a split pencil.

[6] Here let the teacher place the two parts of his pencil together.

III Uses.

(1) To write and draw with.

(2) Carpenters and joiners use them to mark their work with.

SEALING WAX.

MATTER.

I. Preparation of Sealing Wax.

The materials used in the manufacture of sealing wax are lac, resin, and vermilion. Two sorts of lac may be used, either shell or seed; the former is superior. Venice turpentine may be substituted for resin, but it is inferior. These ingredients, having been mixed in certain proportions, are melted over a slow fire, and when thoroughly combined, are poured into moulds or rolled into sticks. In the latter case,

METHOD.

When we have written a letter, enclosed it in an envelope and directed it, it sometimes happens that we want to make it more secure than the self-adhesive principle can. What material do we use for this purpose? **Sealing Wax.**

the soft wax is put on a copper plate and rolled with a board lined with tin or copper. But the polish has now to be given it.

For this purpose a furnace in the shape of a bucket is used, with notched edges. In these edges the sticks are laid and turned about until the surface becomes smooth and shining. The vermilion and shell-lac are both omitted when cheapness is an object: hence the wax made is of a very inferior quality.

Black sealing wax is prepared in a similar manner, except that ivory black is substituted for vermilion, and in the commoner kinds, lamp-black.

Most of the cheap wax sold in our streets and in small shops is a common sort, coated with a layer of superior wax, which is placed upon it while in a liquid state.

II. Substitutes for Sealing Wax.

(1) The Egyptians and also the Romans, as well as other Eastern nations, used a sort of earth, called "sealing earth."[1] The Egyptians selected the oxen to be sacrificed by placing some paper on their horns, sealed with sealing earth, and stamped with the sacred seal.

(2) Cicero was enabled to prove the authenticity of a document by sealing earth. Both documents purported to have come from Asia. The real one was sealed with sealing earth; the other with wax; hence the contradiction and the detection of the fraud.

(3) This sealing earth was used by Eastern Emperors.

(4) At last this earth gave way to a sort of *paste* made of flour, and this in turn was superseded by a composition called "maltha," which was made of pitch and wax.

(5) Then came another material, called "*soft wax*."

[1] Why so called? Because it possessed an adhesive property.

III. Preparation of Soft Wax.

This was a great improvement upon earth.[2]

(*a*) IN ANCIENT TIMES. At first yellow was the prevailing colour, afterwards white. Then in the 14th century, many attempts were made to produce fanciful colours, such as green and black, &c. At this period the blue tint was first adopted by mixing a vegetable blue with the wax when in a liquid state. Considerable difficulty attended the making of this blue wax;

[2] How? Because the earth was liable to crack and crumble to pieces.

hence it was of great value, and the use of it was esteemed a privilege; *e.g.* Charles V. of Germany, gave Dr. Stockamar of Nuremburg, permission to use blue wax.

(*b*) IN OUR OWN TIME. The ingredients used are one lb. of wax, 3 ozs. of turpentine, and 1 oz. of olive oil. These are put into a vessel over a fire and allowed to boil for some time. The mixture is then fit to be made into rolls or cakes. The various colours are imparted by stirring in, while hot, the required tint. The perfume attending wax is also added in the same way.

The wax thus made is brought to its proper consistency by pouring it, while hot, into a vessel of cold water.

REMARKS. As one of the ingredients used in the manufacture of sealing wax is shell-lac, and as this is a production of Eastern countries, it is supposed that it was first invented in those countries.

The University of Gottingen[3] contains two sticks, called "Turkey wax." They are angular,[4] bent like a bow: neither stamped[5] nor glazed, and are of a dark red.

In the same collection are two other sticks which came from the East Indies. These are straight, glazed, thin at both ends, have no impression, and are of a dark dirty colour.

Sealing wax was in use in Europe about 300 years ago: proof—a letter is still to be seen, dated August 3rd, 1554, and sealed with modern wax.

[3] In Germany: shew on the map.

[4] Illus. on blk. bd.

[5] Allude to the stamp (often the maker's name) on our sealing wax.

A CHINA TEACUP.

MATTER.

I. Locality of Manufacture.

The best China is made at Worcester: the "Potteries" of Staffordshire also produce much of a good quality: also Dresden, in Germany.

II. Stages of the Manufacture.

(1) China consists of the finest clay and flint, which are ground and mixed with other substances; the roller used in grinding them weighing nearly two tons.[1]

METHOD.

Out of what do we drink our tea or coffee? **A Teacup.**

Of what are the best teacups made? **Of China.**

[1] To give the class an idea of this weight, refer to two tons of coal, which may be considered an average load for two horses.

(2) The mixture is then burned, after which it is again ground, mixed with water, and passed through sieves.[2]

(3) The liquid mixture is then placed in troughs, with fires under them, till it is baked to the consistency of clay, after which it is beaten and cut into pieces.

(4) The potter next receives them at his lathe,[3] where he turns them into their proper shape, and reduces their thickness to about one-half. They are then once more burned for about 2½ days, when they are called "*biscuit*," and are ready for painting.

(5) The patterns upon china tea-cups are often hand-work, the colours being laid on with a brush as in painting a picture, but they are mixed with oil or turpentine. They are rendered permanent[4] by the action of heat.

(6) Lastly, the articles are burnished. This is done by females, who employ, for the purpose, a hard smooth stone, called an "*agate*," a piece of sheepskin, some white lead, and vinegar. This process requires so much care that it is never undertaken unless the hands be first gloved with clean white linen.

[2] Why? Illus. by reference to cleaning currants.

[3] A machine used for turning materials (chiefly wood, ivory, or bone) into a given shape.

[4] i.e., "lasting;" or, as linen drapers say, "fast," or "fixed."

III. Qualities.[5]

China is semi-transparent, brittle, malleable,[6] and fusible.

REMARKS. Hand-painted china is very dear, a dessert service, of handsome design, sometimes realizing as much as one guinea per piece. This arises from two causes:

(*a*) Painting by hand is a slow process.

(*b*) It can only be undertaken by very skilful workmen, who must be paid high wages.

[5] Ask for other materials possessing these qualities.

[6] So called because it may be "hammered out." (Refer to a "mallet.")

Reconcile the apparent discrepancy between "brittle," and "malleable," by shewing that the former is a quality of china when manufactured, the latter, when it is in a clay-like state.

A NEEDLE.

MATTER.

I. Stages of Manufacture.

(*a*) CUTTING. Needles are made of soft steel wire, which is first cut into lengths long enough for two needles, then made up into bundles and straightened.

(*b*) POINTING. They are then pointed by grinding them on a stone wheel. The grinder takes a bundle in his hand, and, as the wheel

METHOD.

What do we sew with? **A Needle.**

(The teacher should have one at hand for the sake of illustration.)

revolves,[1] brings the end of each wire in contact with it. In this way he points several at once. An expert hand can get through 7000 in an hour. This is the most unhealthy part of the manufacture.[2]

(*c*) MAKING THE EYE. The eye is next made, by first flattening one end of the needle, and then piercing it with a punch.

(*d*) TEMPERING. Our needle is now once more straightened (for during the latter process some of them will have become crooked) by dipping it into water, and then drying it over hot plates. This hardens or tempers them.

(*e*) FILING THE HEAD. The head is then filed smooth by boys, who also make the gutters on each side of the eye.[3]

(*f*) SCOURING AND CLEANING. The needles are now scoured, which is done by placing many thousands together upon coarse cloth covered with oil, soft soap and emery powder.[4] After this they are tied up and rolled to and fro as in a mangle. They are then polished by girls and boys, and packed in papers ready for sale.

[1] i.e., turns round. (Illustrate by a cart wheel.)

[2] Why? Because the steel filings and the dust of the grindstone get into the lungs of the workman, and often in time cause his death. (Illus. by the somewhat parallel case of stone masons.)

[3] Refer to the needle.

[4] Dust obtained from a very hard stone. Used as sand paper for polishing; but it is much harder.

II. Locality of Manufacture.

Needles are made principally at Redditch, in Worcestershire,[5] about twelve miles from Birmingham. Some of the finest are made in Whitechapel, a district in London.

REMARKS. From the manufacture of needles we see:

(*a*) The advantage of division of labour.[6]

(*b*) That simple articles are often the result of great labour. From the time the steel leaves the mine as iron, until it becomes a needle fit for use, it has passed through no less than 120 hands.

[5] Shew on the map.

[6] Explain: and shew that in this way each person becomes perfect in his part of the process, and that this results, directly, in a saving of time, and, indirectly, in a cheaper article.

A STRAW BONNET.

MATTER.

I. Locality of the Manufacture.

Straw bonnets are made principally in Buckinghamshire, Bedfordshire, Hertfordshire, and Essex.[1] Of these, the most important district

METHOD.

A few years ago what very common material was used in making bonnets? **Straw.** The bonnets thus made were called **Straw Bonnets.**

[1] Shew on the map.

is Bedfordshire, Dunstable being the seat of the trade.[2]

II. Stages of Manufacture.

(*a*) Straw bonnets are made, as their name implies, from straw. This is collected, by women and children, and sold to the manufacturer for about twopence per pound. The first process it undergoes is that of clearing away every thing not required in the manufacture, such as leaves, &c.

(*b*) The straws are then cut into lengths, sorted, and tied in small bundles.

(*c*) They are then split by means of a pointed wire having sharp teeth. Along these the straws are dragged, and are thus divided.

(*d*) After this they are flattened between wooden rollers, and then handed over to the plaiters.

(*e*) The plaits are called by various names, according to the number of straws employed in making them. There are the *Rustic* of four straws, the *Devonshire* of seven, the *Diamond* of twenty-three, and so on.[3] The plaits are sold in scores, or pieces of 20 yards long: three of these will make a medium-sized bonnet. A good plaiter makes half-a-score a day.[4]

(*f*) Sometimes the plaits are bleached;[5] after which they are sown and made into bonnets, which are then pressed and are ready for sale.

REMARKS.—Very beautiful hats and bonnets are made at Tuscany, in Italy. The straw of which these are made, is much finer than that which is commonly employed, and the articles produced are superior to those of any other district.[6]

Children are taught to plait at the age of three years. It is the prevailing occupation of the female portion of the population, in the counties already mentioned. Nor is it unhealthy, the plaiters often performing their work, except in winter, in the open air.[7]

---

[2] Shew how the manufacture has suffered since the recent fashions were introduced.

[3] Illus. this process by reference to the plaiting of hair.

[4] Calculate the time required to plait enough for a bonnet; viz., a week.

[5] i.e., Whitened. (Refer, by way of illus. to "unbleached calico.")

[6] Hence the cost of "Leghorns" and "Tuscans," which were so fashionable a few years ago.

[7] Contrast this fact with the condition of our cotton operatives, who are closely confined in the manufacturing towns of Lancashire and Yorkshire, from 6 a.m. to 6 p m. the whole year round.

A CANDLE.

MATTER.

I. Parts of a Candle.[1]

(*a*) THE WICK. This is composed of cotton, either loosely twisted or closely plaited according to the quality of the candle.[2]

Our cotton wick comes chiefly from Turkey: it reaches us in the form of skeins.[3]

(*b*) THE TALLOW. This consists of the fat of oxen and sheep, which is harder, when cold, than that of other animals. The fat is melted in a large boiler, and purified, after which it is taken out of the boiler in buckets and put into casks to cool.

Our tallow comes chiefly from Russia.[4]

II. How manufactured.

The wicks are fastened by means of the loop, which we see at the end of the candle, to long rods. Then, having provided his *dipping mould*, i.e., a box with the tallow in it, the workman takes a number of sticks and dips them into the liquid fat.[5]

This process is repeated until the candles are of the proper size, according to the number required to make a pound; *e.g.*, eights, tens, twelves, and so on.[6]

(2) MOULDS. Composite candles are made in moulds, and are therefore sometimes called called "*moulds*" to distinguish them from dips. The mould consists of a frame of tubes with a shallow trough at the top. Into this trough the candle maker pours the fat, which then runs into the tubes, and forms, when hard, the composite candle.

(3) WAX. The best candles are made of wax obtained from bees, and bleached by exposing it on linen cloths to the action of the sun and air.

The wax is placed round the wick and the candles are then rolled on a smo th table till they are quite round.

(4) SPERMACETI. Another kind of candle is made of spermaceti, which is the fat of a species of whale. It is mixed with tallow or wax.

N.B. The use of candles is so well known that a separate head for this portion of the lesson is not required.

METHOD.

What have we besides gas and paraffin lamps to give us light? **Candles.**

[1] Let these be given by the children.

[2] Explain and refer to the difference between the wick of a "dip," and that of a "composite," or of a "wax" candle.

[3] Compare skeins of thread, &c.

[4] Shew on the map.

[5] Hence the term "*dips*" for common candles.

[6] Explain and shew that common expressions are often used without knowing their true meaning.

REMARKS. The peasantry of many countries, our own among the number, make candles of split rushes, which they obtain from the banks of a river, and smear over with fat. These lights are called "rushlights."

WHY DOES A CANDLE BURN? The cotton being lit, the tallow melts and rises into it. So long as there is sufficient fat to feed the wick, so long the flame continues to burn; but as the wick of a common dip is so large, the snuff collects at the top. This is taken off by the "snuffers."[7]

This lesson may be enlarged, if intended for an upper class, by treating of the structure of flame. (*Vide Wilson's Chemistry; by W. and R. Chambers.*)

[7] Ask the class what they have seen like snuffers. They will probably say "scissors." Accept this answer and add that a little box is fixed to one leg of the snuffers, the object of which is to collect the burnt wick.

PAPER MAKING.

MATTER.

I. Substances formerly used as substitutes for paper.

(1) INNER BARK OF TREES. This was prepared by scraping all knots from the surface and thus rendering it as smooth as possible.

(2) PAPYRUS.[1] A reed-like plant growing on the Banks of the Nile. It was thus prepared: The long, narrow leaves[2] were laid side by side; then others were placed upon them at right angles,[3] the whole being moistened with Nile water. This caused them to adhere, after which they were dried, and polished with a smooth stone.

(3) SKINS OF ANIMALS. The sheep and the goat were the animals generally chosen. In order to prepare the skins they were first soaked in lime water to remove all impurities, after which they were laid upon a wooden frame and all roughnesses scraped off. Skins so prepared are called "*parchment*," from Pergamos,[4] in Asia Minor, where they were first used.

Vellum is a superior kind of parchment, made from the skin of a young calf.

(4) TABLES OF WAX. These were tables overspread with wax, upon which the characters were traced with an iron instrument, called a "*stylus*," sharp at one end, like a lead pencil,

METHOD.

If we wish to let our friends, at a distance, know how we are getting on, what do we do? **Write a letter.** On what do we write it? **Paper.**

[1] Meaning of this word: "To stand instead of."

[2] Compare the leaves of the blue iris.

[3] Explain and illus. by a diagram.

[4] Shew on the map.

and chisel-shaped at the other to erase any mistakes.[5]

II. Process of manufacture.

(1) After the rags (white and coloured) have been collected by the ragmen, who are chiefly Jews, they are sold to the paper-maker, who gives for them according to their value. They are then put into a cylinder, in which are a number of sharp spikes. This cylinder is made to revolve with great rapidity, and, as a matter of course, it tears to pieces the rags it contains. By this means they are reduced to a pulp.[6]

A quantity of lime thrown in during this process has rendered the rags quite white.[7]

(2) At this stage of the manufacture a man, called a "dipper," stands by the vessel containing the pulp, with a mould in his hand. This mould is made of wire, stretched upon a wooden frame. This he dips into the vat, and having taken up a certain quantity of pulp deposits it upon a sheet of felt.

(3) Upon this, another sheet of felt is placed, and then the process repeated, until a number of layers are made.[8] The whole pile is then subjected to a heavy pressure.[9]

(4) On looking at a sheet of this paper it will be seen that there are lines upon it.[10] These are the marks of the wire frame to which we have alluded. Very often the name of the maker is in the frame (done by twisting the wire when the frame is made): this one may see by holding a piece of foolscap against the light, when the letters of the name will be distinctly visible.

(5) But the paper is not yet fit to write upon. If ink were applied to it in its present state, it would run as blotting paper does. To prevent this it is sized,[11] i.e., a kind of glue is spread over it. Once more the moisture is expressed, and

(6) It is then counted out into quires of 24 sheets each and folded, after which it is made up into reams of 20 quires, pressed, and tied up in wrappers for sale.

III. Varieties of paper.

(1) BEST SATIN NOTE. Made by passing the paper between smooth pasteboards which are heated by sheets of iron.

[5] Refer, by way of illus. these tables, to the naming of John the Baptist as recorded in St. Luke i. 63.

[6] What is meant by a "pulp?" (Illus. by reference to mashed turnips, &c.)

[7] i.e., they are now bleached.

[8] Illus. by reference to slices of bread and butter.

[9] This is done to take away all moisture. (Comp. the wringing of wet cloths.)

[10] Exhibit a piece.

[11] Hence blotting paper is made without size.

(2) BROWN PAPER. Made of canvas, sacking, and other coarse materials.

(3) PASTEBOARD AND CARD. Consist of several layers of paper made to adhere by pasting them together.[12]

[12] That this is the case may be proved by examining the edges of cardboard when the several layers may be readily separated by means of a penknife.

BOOKS.

MATTER.

I. Explanation of terms.

(*a*) MANUSCRIPT.[1] These were books written by hand, before printing was known. The Bible was so written in ancient times. Those who wrote it were called *Scribes*. In the Middle Ages the monks were the copyists. These manuscripts when filled were *rolled up*, and hence were called *volumes*.[2]

(*b*) LIBRARY.[3] In former times books were made of bark: the Latin word for bark is "*liber*," hence the place appropriated to the reception of books is termed a "*library*."

II. Sizes of books.

Books are of various sizes, according to the number of leaves into which the sheet is folded: Thus we have—

(*a*) Folio	2 leaves to a sheet		(fo.)
(*b*) Quarto	4	„ „	(4to.)
(*c*) Octavo	8	„ „	(8vo.)
(*d*) Duodecimo	12	„ „	(12mo.)
(*e*) Eighteenmo	18	„ „	(18mo.)

REMARK. The teacher may conclude the lesson by a short allusion to the covers of books and the materials used in making them: also to bookbinding and stamping.

METHOD.

When an infant has mastered the alphabet it begins to read. Out of what does it read? **Books.**

[1] Explain the terms "manuscript," "scribes," "middle ages," and derive the two former, if the lesson be given to an upper class.

[2] From "*volvo, volutium*," (L.) I roll. (Refer to Jer. xxxvi. 2.)

[3] What is a place called, where a large collection of books is kept?

A LOOKING GLASS.

MATTER.

I. Component parts.

There are three materials used in the looking-glass manufacture. They are—

METHOD.

In dressing ourselves, we sometimes want to see how to put on some article

(*a*) GLASS. This is the best that can be made. It is called "*plate glass.*"[1]

(*b*) WOOD. Generally lime wood[2]

(*c*) SILVER. This is properly quicksilver or mercury. It is supplied chiefly from Almaden in Spain, where is the richest mine in the world.

II. How manufactured.

Having selected a suitable piece of glass, it is placed on tin foil (sheets of tin). Over it is then poured a mixture of melted tin and quicksilver. A weight is then placed on it.[3] When the metal is dry, it becomes hard and adheres firmly to the glass.[4]

But this quicksilver would soon wear off if something were not done to protect it. Here then is the use of the *back-board.*

At this stage the frame is added. If the looking glass be intended for use in a gentleman's house, the frames are gilded. But before this can be done, they are covered with size, &c.[5] When the gilding is dry it is burnished.[6]

III. Use.

To assist us in dressing.

N.B. Refer to the brazen mirrors of the Israelitish women, of which the brazen laver was made. (*Vide* Exodus xxxviii. 8.)

of our apparel: What have we which enables us to do this? **A Looking Glass.**

[1] Refer to shop windows, omnibus windows, &c.

[2] Notice the framework of a looking glass, and draw attention to the fact that only the most expensive are carved wood, the others being moulding of plaster of Paris.

[3] Why?

[4] Here explain the principle of reflection, and refer by way of illus: to

(*a*) The lake, which is Nature's mirror, and the N. American's looking glass.

(*b*) Mahogany table or other polished surface.

(*c*) The back of a watch.

[5] Explain and illus. by reference to letter-gilding over shops.

[6] Polished.

A BED.

MATTER.

I. Substitutes for beds.

Beds are now used in all civilized countries; but the materials of which they are composed are not always alike.

The following are substituted for beds, in some parts of the world:

(*a*) SKINS OF ANIMALS. These are mostly used in very cold countries. The animals, from which the skins are obtained, are taken in the chase,[1] then killed, their skin stripped off and their flesh eaten. Other countries use

(*b*) DRIED RUSHES, LEAVES, &c., and others again.

(*c*) STRAW. Our kings' beds were once made of straw, and the peasantry slept on straw pallets as late as Henry V.[2]

METHOD.

After a hard day's work we naturally feel tired and go to—**Bed.**

[1] Refer to the ancient Britons.

[2] Give the date (1413–1422) and shew that we have much cause to feel thankful for our comforts.

Straw is used as parts of beds at the present day,[3] and English navvies and Irish labourers frequently sleep on nothing else.

II. Parts of a bed.[4]

(1) THE MATTRASS. Stuffed with horse-hair, wool, or straw. On this is placed

(2) THE TICK, which is the principal part of the bed, and consists of a large bag stuffed with feathers or flocks.[5] Feathers are the best stuffing, because

(1) They contain a certain degree of elasticity.[6]

(2) They are easily shaken and made soft. The feathers are plucked from tame geese three or four times a year. The finest are those obtained from Norfolk and Suffolk. Many geese are captured around Hudson's Bay,[7] their flesh eaten and the feathers exported to England. Some are also imported from Dantzic, in Prussia.

(3) SHEETS. Made of linen, which is manufactured from flax, a plant grown largely in Russia, Holland, and Belgium.[8]

These are the best sheets; inferior ones are made of cotton, obtained from N. America, Egypt, &c.

(4) BLANKETS. Made of wool, chiefly at Witney, in Oxon.[9]

All the above, together with

(5) THE COUNTERPANE, made of woven cotton, patchwork, or eider down,[10] are laid upon a framework of wood or iron called

(6) THE BEDSTEAD. Around this are often hung rough woollen or cotton stuffs, and sometimes rich damask[11] drapery. These are

(7) THE BED FURNITURE.[12]

N.B. The use of a bed is too well-known to need a separate head.

The teacher may enquire of the class (if it contain girls) how they would set about making a bed.

[3] For what? Stuffing mattresses, &c.

[4] Let these be obtained from the class, especially the girls, if any there be in it.

[5] The former obtained from geese.

[6] Explain this.

[7] Shew on the map.

[8] Shew on the map.

[9] Shew on the map. Why called "*blankets?*" From Thomas Blanket, of Bristol, who first made them.

[10] The finest feathers of the Eider duck common in the North of Europe.

Shew the advantage of these quilts: they are very warm and yet light; but too expensive for any but the rich.

[11] So called from "Damascus." Explain.

[12] Shew that it is far healthier to be without this, and why?

GLASS.

MATTER.

I. Discovery and antiquity of glass.

Some merchants were wrecked on the coast of Syria, near the river Belus, at the foot of

METHOD.

Of what are our windows made? **Glass.**

Mount Carmel.[1] As the sailors had no stones to rest their cooking utensils upon, they employed pieces of their cargo (alkali). This when melted mixed with the sandy flint of the river, forming a stream which was glass.

The first mention we have of glass dates about 3000 years ago, when some Egyptian mummies adorned with beads of earthenware, covered with glass, were discovered.

Glass is also mentioned by a Greek poet 423 B.C. When the art was first known, articles of ornament formed the principal manufacture. Afterwards glass drinking cups were made, but were enormously dear at first. (Nero, the emperor of Rome, gave £50,000 for two, with handles.)

GLASS WINDOWS have a later date: first mentioned by St. Jerome 422: again by a writer of the seventh century, as being fastened in with cement.[2]

Some have supposed that the art was known to the Druids, and the supposition is strengthened by the fact that a quantity of Druidical remains were discovered, containing a number of coloured (glass) beads.

[1] Shew on the map.

[2] Windows were not used in private houses till the reign of Henry II., 1180.

Shew how wretched houses must have been without glass (horn was substituted), and hence shew cause for gratitude.

II. Process of Manufacture.

The materials employed in glass-making are principally three:—Sand, alkali, and lime. The sand and alkali are first mixed, put into a furnace and burnt for some time. This is called *grit*. It is then cleared over a second furnace to prepare it for the glass-blowing process. The blower takes some of the melted glass with the end of a long iron tube, rolls it on a stool into its proper shape, and then blows into it to make it hollow. At this stage he must be very particular; the glass must not be suddenly exposed to the air, or it would fall to pieces as if struck with a hammer. It must be again *heated* and allowed to cool very gradually. This is called *annealing*.

III. Qualities.[3]

[3] Let these, as far as possible, be given by the class, and ask for other substances possessing them.

Glass is—

(*a*) Transparent. It is this which renders it of so much use for windows.

(*b*) Smooth.

(*c*) Brittle.

(*d*) Fusible.

IV. Localities of manufacture.

(1) IN ENGLAND. Principally at Newcastle-on-Tyne, St. Helen's, Warrington, and Birmingham.[4]

(2) IN EUROPE. Berlin, Bohemia, and Paris.

[4] Shew on the map.

V. Kinds of Glass.

There are five principal varieties of glass: (*a*) Flint, (*b*) Plate, (*c*) Crown, (*d*) Broad, (*e*) Bottle.

(*a*) FLINT. Is of great weight and very strong; is very useful for telescopes.

(*b*) PLATE. So called because manufactured in large pieces, called "*plates.*"

It is rolled, when in a half-melted state, by large iron rollers: afterwards ground to remove all flaws, and polished.

(*c*) CROWN. Is harder and lighter than the other kinds: is the best window glass.[5]

(*d*) BROAD. Commoner kind, made of inferior materials: is consequently cheaper and also less satisfactory.

(*e*) BOTTLE. The commonest kind, made of the coarsest materials.[6]

[5] Explain the knot often seen in crown glass: it is the point at which the rod, used in whirling the glass round, was attached.

[6] Refer to its dark green colour, as seen in bottles, and explain it by referring to the fact that bottle glass is made of sea-weed and lime.

VI. Uses.

(*a*) FOR WINDOWS of houses, carriages, &c.
(*b*) FOR OPTICAL INSTRUMENTS.[7]
(*c*) FOR ORNAMENTS of various kinds.
(*d*) FOR BUILDINGS.[8]

[7] Ask for the names of some.

[7] Refer to the Crystal Palace.

PINS.

MATTER.

I. Stages of the manufacture.

(1) STRAIGHTENING. Pins are made of brass wire, which is first beaten, hardened, and cleaned. The first process to which the wire is subjected is straightening. This is generally performed by a woman assisted by a girl.

(2) CLEANING. The wire is again cleaned. This is done by soaking it in water rendered acid by the addition of vitriol. This eats away any dirt which may adhere to the wire.

(3) CUTTING. The wire is next cut into lengths, each long enough for six pins.[1] The next process is

METHOD.

What is this? (Teacher holding a pin in his hand.) **A Pin.**

[1] Compare with the corresponding process in needle making.

(4) GRINDING AND POINTING, which is done in the following manner: a man takes a bundle of wires in his hand (generally from 50 to 80)[2] and brings them first into contact with a revolving wheel, cut like a file, and afterwards they are placed upon another wheel of a finer kind. The wire is then cut into six parts and each pin pointed. In most cases a man, with his wife and child, works at the pointing. A family of three can earn six or seven shillings a day.

[2] Shew how tedious it would be if each pin were ground separately.

(5) MAKING THE HEAD. The heads are next made by twisting fine, soft wire round a mould, which is the same size as the stem of the pin.

They are then heated in an iron ladle, until they are red hot, after which they are hardened by cooling, and are passed to another set of women and children. These are constantly

(6) PUTTING ON THE HEADS, which is done by taking up a handful of stems and dipping them into a bowl, containing a number of heads. In this way a great number are fixed on at once.

(7) FASTENING THE HEAD. But the head thus put on is liable to come off, as some of us have found to our cost. They must therefore be fastened securely to the stem. This is done by means of a machine, which is made to descend with considerable force on the head of the pin.

In some pins the head and stem is in one piece. This is done by the aid of a machine which punches them out of a solid piece of wire, at the rate of 60 per minute.[3]

[3] i.e., one every second.

(8) WHITENING AND TINNING. Our pin is now made, but it is not yet fit for use. It must now be whitened and tinned. For this purpose they are first put into an acid liquor[4] to clean them and then boiled in tin. In about two hours they are coated and taken out.

[4] What is acid? Ask for the name of any acid.

(9) POLISHING. They are then polished by putting them into a tub of hot bran, which is made to revolve so quickly, that the pins, rubbing one against the other, become very bright.

(10) STICKING. Having separated the pins from the bran, they are stuck in rows by children, who, by constant practice, become very expert.

Thus we see that ten persons are employed upon the manufacture of a single pin.[5]

[5] Shew from this, as in the case of a needle, the value of division of labour.

REMARKS. The use of pins is so well known as not to need a separate head. As many as 15 millions of pins are made daily in England. One of the chief places famous for this manufacture is Gloucester.[6]

[6] Shew on the map.

BONES.[1]

MATTER.

I. Kinds of bones.

(*a*) LONG BONES. Of this kind we have examples in the bones of the arm and leg.

(*b*) ROUND BONES. Of these we have instances in the ankle, the extremities of the bones of the upper part of the leg, and of those of the arm.

(*c*) BROAD AND FLAT BONES. Such as those of the knee and of the shoulder blades.

II. Structure[2] and composition of bones.

Bones are porous, i.e., they are full of holes.[3] This might be experimentally demonstrated by forcing air through them, if only suitable machinery could be found.

Bones are chiefly composed of gelatine (a substance resembling glue), carbonate of lime (commonly called chalk), and phosphate of lime. In infancy the bones are almost entirely gelatine: they harden as age advances.

Throughout the bones there are very minute blood-vessels placed, which carry nourishment to them, and so keep them in a healthy condition.[4] Through the centre of the bone there is also a tube or hollow, extending its whole length.[5] This is filled with marrow as the middle of a stick is supplied with pith. As old age advances this marrow dries up, and hence it is that the bones of old people so easily break.[6]

Where bones are constantly rubbing against each other,[7] they are covered with a kind of gristle, called "*cartilage*," near which is secreted a fluid, for the purpose of moistening the joints.[8]

III. Uses.

Taken in connection with our body, bones are of three uses:

METHOD.

In clasping our wrist, what is the hard substance we feel? **Bones.**

[1] This lesson may be rendered more suitable for an upper class, by treating the subject more scientifically, in which case the proper names for the various bones should be given.

[2] What is meant by this word? A building is termed "a structure."

[3] Illus. by reference to a piece of cane, which in this respect very much resembles a bone. Our skin and sponges are also porous.

[4] That this is so may be proved by feeding a rabbit upon madder root, in which case the bones will be found tinged with the colour of the root.

[5] This secures strength and lightness.

[6] Illus. by reference to a dry stick.

[7] Elicit, if possible, instances from the children: *e.g.*, the upper bone of the leg (the femur), and the bone of the upper arm (the humerus), may be mentioned, the rounded extremities of which play in corresponding hollows.

[8] This will be more readily comprehended

(1) They give strength and firmness to the body, the flesh hanging, as it were, upon the bones.

(2) They protect various parts from injury, *e.g.*, the bones of the skull protect the brain, and those of the chest and ribs, the heart and and lungs.[9]

(3) They allow free motion to the different parts of the body.

The bones of animals are used

(4) As a manure. About 70,000 tons are annually imported into this country, chiefly from South America and Russia. They are ground to powder and then scattered over the land.

(5) For handles of knives and forks, tooth brushes, &c. These are the larger kinds—the shank bones. Immense numbers of these bones are used annually at Sheffield.[10]

if illus. by reference to machinery, the parts of the machine answering to the bones of the body, and the oil applied to the former representing the fluid which assists free action in the latter.

[9] Notice the wisdom of God in this arrangement.

[10] Why at Sheffield? Because it is the chief seat of the cutlery trade.

THE FEET OF ANIMALS.

MATTER.

I. Feet of Quadrupeds.

(1) COW. Intended to inhabit soft localities, as meadows and river banks : hence has cloven feet.[1] By means of this provision a cow can feed where a horse cannot.[2]

(2) HORSE. Intended to tread upon firm, hard ground, hence we find they are furnished with a hoof which does not give way, because it consists of a single piece and is provided with a shoe.

(3) GOAT. Designed to be the inhabitant of rocky localities, hence its sharp hoof, suitable for climbing.[3]

(4) CAMEL. (*See the cow.*)

(5) RABBIT. Here a two-fold object had to be provided for : viz., running and burrowing.

To accomplish this its forelegs are short and strong, and possessed of a powerful hand as it were, while the hind ones are serviceable both as feet and as a lever.[4]

(6) MOLE. In the mole we find all the legs short.[5] Its feet are provided with powerful muscles, which cause an expansion of them into a form somewhat shovel-shaped.[6] The foot too is turned aside.[7]

METHOD.

We will notice today the feet of animals.

[1] What are they? Comp. those of the camel.

[2] Shew how this is.

[3] The hoof acts as a spike, thus rendering the animal sure-footed.

[4] Ask for similar cases : hare, kangaroo.

[5] Why? Long ones would be inconvenient to an animal living underground. Explain this.

[6] Shew how this aids it in burrowing.

[7] Object of this. It does not impede its own progress by casting the dirt in front of it.

(7) CAT. Here is a wonderful contrivance, and one which is frequently seen without observation. A cat is in need of a hand to seize (as the eagle) also a suitable foot for walking. At first sight there appears little difference between the foot of a cat and that of the dog, but a closer inspection will shew the contrary. Cats walk upon their toes, hence they require protection for the claws.[8] This they have in the sheath which encloses them.

A cat also feeds on animals that are quick of hearing,[9] hence the pads with which their feet are covered, the object of which is to deaden any noise occasioned by their tread.

(8) RAT. } All intended to walk on
(9) MOUSE. } inclined surfaces.[10] The
(10) WALRUS. } Walrus, or Seahorse, on inclines of ice (icebergs, &c.), hence the foot is so constructed as to produce a vacuum and so adhere to the ice.[11] The feet of rats and mice are furnished with sharp claws.

II. Feet of birds.

Some birds walk, others are designed to climb.

(1) WOODPECKER. Is furnished with long claws behind to afford a prop when climbing.[12]

(2) FALCON. Is a bird of prey, and is therefore furnished with long claws, which take, as it were, the place of hands.

(3) DUCK. In swimming birds the feet are webbed.[13] The foot of the duck is also provided with a heel joint, so that the action of the water against it works the paddle as it were.[14]

(4) HERON. This bird preys upon small fish, found in shallow water; hence in order to seize this prey, it is provided with serrated claws.[15]

(5) SEA-BIRDS. Live on bare rocks; make no nest: hence their eggs would be liable to be broken when they rise into the air, but for the hand-like extremities with which their legs are furnished. With these they lay hold of the eggs as they soar into the air.

III. Feet of Insects.

Insects walk on a variety of surfaces: some on land; others above the earth are flying in the air; others again live on leaves, fibres, and polished surfaces. Upon these they exist in all sorts of positions.

In all of them the construction of the feet is similar. (Notice the Spider, Fly, and Grasshopper as illustrations).

[8] Why? Otherwise they would become blunt and useless as a means of catching their prey.

[9] Ask their names.

[10] Explain.

[11] Explain and illus. by the action of a sucker.

[12] Explain and illus. by diagram on blk. bd.

[13] To act as oars. Shew how.

[14] Ask for other illus. of this principle. Coot and water hen.

[15] Explain and illus. "serrated," by reference to a saw.

N.B. The teacher, in concluding the lesson, should give the class to understand that all the instances to which he has directed their attention go to prove one fact, viz.,—That as is the destination and design of each animal, so also is the construction of their feet.

THE TAILS OF ANIMALS.

MATTER.

Animals use their tails[1]

I. To express their emotions.

Examples :—lion (its fury).
dog (its pleasure).
cat (fright).

II. As fly brushers.

Examples :—Cows and horses.[2]

III.—As a defence.

Examples :—Whale—upsets boats.
Kangaroo—can break a man's leg.
Wasp } Sting may be regarded
Bee } as a tail.

IV.—As hands.

Examples :—Monkey—South American monkeys have prehensile tails.[3]
Rats and mice in a less degree.

V. As a rudder.

Examples :—Fish—in swimming.
Birds— }
Squirrels— } in flying.

METHOD.

To-day we will have a lesson on "**The Tails of Animals.**"

[1] Let this lesson, as far as possible, be so handled as to call forth the thinking powers of the class.

[2] Shew how necessary is a tail to horses of the Pampas.

[3] Why so called? Derive the word in an upper class, and shew how monkeys leap from tree to tree, by means of their tails.

TEETH.

MATTER.

I. Description of teeth.

(1) SITUATION. The teeth are fixed in the jaws, in that portion of them called the gums.

(2) NUMBER. The number of teeth varies, according to the age of the individual.[1] Children up to the age of fourteen have 20. The full number is 32; 16 in each jaw.[2]

(3) KINDS OF TEETH. On looking at a set of teeth we see they are not all alike; some are pointed, others chisel-shaped, while some are almost square.[3]

METHOD.

With what has God provided us, in order to make our food fit for the stomach?

Teeth.

[1] That this is so, a reference to infants will shew.

[2] Refer to the "shedding" of teeth, and illus. by the "moulting" of birds.

[3] Shew the object of this provision, viz.,

We have four kinds of teeth :

(*a*) Incisors. Four in number and chisel-shaped.

(*b*) Canine ; also called "eye-teeth," and "dog's teeth," because they are pointed like those of a dog. Two in number.

(*c*) Small grinders. Four in number.

(*d*) Large grinders. Six in number.[4]

These make 16 and 16 × 2 (for the two jaws) = 32.

(4) STRUCTURE.[5] The teeth, at first, are mere pieces of jelly. By degrees, a hard speck is visible in the soft mass. This is *the tooth*, and it continues to grow till *all* the jelly-like substance becomes bone. The tooth is then formed.

But this bone, though hard, would not serve us a life-time ; hence we find our teeth furnished with a very hard covering. This is called "*enamel.*"[6] Each tooth consists of three parts : (*a*) The crown, (*b*) The neck, (*c*) The fang.

(*a*) The crown.[7] The visible part.

(*b*) The neck. The part where the tooth enters the gum. It is narrow as though a cord had been tied round it.[8]

(*c*) The fang. The part in the gum.[9]

II. Use.

Known to all ; viz., to masticate our food and so render it fit for the action of the stomach.[10]

REMARKS ON PRESERVING THE TEETH.

(1) Always clean them well on rising.[11] This will help to ward off toothache.

(2) Never pick them. It is a dirty, low-bred habit, and one which wears away the enamel.

(3) Avoid biting hard substances.[12]

to suit our mixed diet. (Comp. with the bear.)

4 Explain what part of the process of mastication each kind of tooth performs ; *e.g.*, Incisors, cut the food ; Canine, tear it ; Grinders reduce it to a pulp.

5 Explain "*structure*," and refer to building a house.

6 Explain "*enamel*," and illus. by reference to saucepans, thus showing that enamel preserves.

7 Illus. by a king's crown.

8 Shew a cow's tooth by way of illustration.

9 Refer to roots of a tree as an illus.

10 Shew the importance of thoroughly masticating our food before swallowing it.

11 Things when constantly cleaned after using, last longer, *e.g.*, saucepans, &c.

12 Because the enamel would be injured. Nuts should be cracked with nutcrackers.

DEW.

MATTER.

I. Formation of Dew.

(1) If a saucer be filled with water and exposed to the air, it will in time disappear. It has evaporated.[1]

METHOD.

When walking through the fields on a summer's morning, we sometimes find the grass quite wet, and this too when there has been no rain, What is the cause of it? **Dew** has fallen.

1 i.e. passed away in the form of vapour.

(2) Again, if a cold plate be placed over hot potatoes, and afterwards removed, we find that it is covered with moisture, or drops of water.

(3) Again, if a glass filled with cold water, or a bottle of wine, be brought into a warm room, from a cold cellar, it will soon be covered with moisture.

(4) If the windows of a full railway carriage be noticed, on a cold day, we find *them* covered with moisture.

From the foregoing we derive the following principle:—*That hot air or vapour becomes condensed, when thrown into contact with bodies colder than itself.*[2]

II. Deposition.[3]

Many circumstances affect the formation of dew; the principal are:—(1) the locality; (2) the character of the object exposed and the nature of its surroundings; (3) the weather.

Clear nights are most favourable to the deposition of dew, because then the heat of the earth passes *at once* into the higher regions, without obstruction, thus causing the ground to cool more rapidly.[4]

Vegetation absorbs much more dew than rocks and stones, because the former is a better radiator of heat, i.e., parts with it more quickly.

III. Use.

To cool the earth and assist the growth of vegetation,[5] thus supplying, to a certain extent, the place of rain.

REMARKS. Dew is very abundant in Palestine and Egypt. Some years ago, in the latter country, a portion of spouting was washed away by dew.[6]

N.B. In conclusion, scriptural allusions to dew may be made (*vide* Deutronomy xxxiii. 13; Psalm cxxxiii. 3; 2 Sam. i. 21).

[2] By a question or two, it may now be drawn from the class, that the surface of the ocean is constantly exposed to the action of the sun, and that in consequence of this, vapour is continually rising into the air. Then shew, from the examples given, that the earth being a cold body condenses the hot atmosphere, thus causing the formation of dew.

[3] Explain this word, and, if the lesson is intended for an upper class, derive it.

[4] Shew that on cloudy nights there would be little or no dew, and why? Illus. by

(1) The practice of gardeners covering their tender plants with awnings, and

(2) Plants, under trees, absorb less dew than those more exposed.

[5] Shew what a blessing is dew to the countries in the Tropics.

[6] Thus shewing how copious must have been the fall.

THE THERMOMETER.

MATTER.

I. Principle explained.

(1) Take a bladder filled with air and place it before the fire. It will be found to increase in size in proportion to its increased tempera-

METHOD.

If we wish to ascertain the temperature of a hot bath, or of a room, we use an instrument called a **Thermometer.**

ture, until, if not removed, it will eventually burst.

(2) Our bodies are larger when we are hot.[1]

From these two instances we see that :

With a few exceptions[2] *all bodies expand by heat*, and

That the greater the heat the greater the expansion of the body.

II. Construction.

The amount of expansion heat produces may be measured by either solids, liquids, or gases. Of these, liquids are generally chosen, for solids expand too little and gases too freely, to be of great use. The liquids employed in measuring heat are spirits of wine, or alcohol, and mercury, or quicksilver; the former being used more especially for low temperatures.[3]

The thermometer consists of a glass tube,[4] terminating in a bulb.[5] This bulb and part of the tube are filled with quicksilver, by a peculiar process, which expels all the air, thus leaving a vacuum : the upper extremity of the tube is then sealed by melting the glass.

But the instrument as thus constructed would not indicate *how much one* body was hotter or colder than another. It must therefore be *graduated.*

This is done as follows :—the thermometer is dipped in melting ice or snow ; the mercury at once sinks to a certain point, called the *freezing point*. It is then plunged into boiling water, when the mercury rapidly rises to another point in the tube. This is called the *boiling point.* These points are marked, respectively, 32° and 212° ; the intervening space being divided into 180°. A thermometer of mercury cannot be graduated below 40°, because at that point mercury itself freezes, but it may be graduated upwards to 570°.[6]

III. Use.

To ascertain various *degrees* of heat.[7]

That the thermometer does not measure the quantity of heat may be shown by the following : Dip it into a basin of water, and then into a wineglassful taken out of the basin, when it will stand at the same height in both, although it is manifest there will be more heat in the basin than in the glass.

(In an upper class derive the word.)

[1] This may be shown by the hand, which when cold may easily be gloved, but swells with heat, so that the glove can scarcely be drawn on.

[2] Water is one of them.

Illus. (1) by cistern pipes in winter; (2) Bomb shells, 13 in. in diameter and 2 in. thick, with their fuse holes plugged with iron, bursting when exposed to the severity of a Canadian winter.

[3] Why? Because spirits of wine, cannot, by any applications of science at present known, be made to freeze.

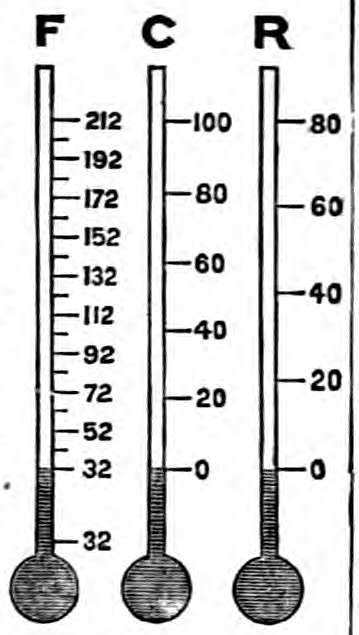
[4] Why glass? In order that its indications may be the more readily noted.

[5] Illus. a bulb by an onion or tulip.

[6] Explain the "zero" of the thermometer, which is 32° below freezing, hence arrive at the graduation of the scale.

[7] Shew its application as seen in (*a*) hot baths ; (*b*) rooms ; (*c*) cucumber frames, &c., &c.

REMARKS. The date of the invention of the Thermometer and the name of the originator are unknown; but it is generally believed to have been invented about the beginning of the seventeenth century. To Reaumur is due the credit of having proposed quicksilver instead of linseed oil, which had been used by Newton. In 1724, a Dutchman, named Fahrenheit, considerably improved it; since then it has undergone little alteration.



In conclusion the teacher may notice the *three kinds* of thermometers, and explain their scales, thus:

(1) Fahrenheit's begins at 32° and ends at 212°.

(2) Centigrade begins at 0° and ends at 100°[8].

(3) Reaumur begins at 0° and ends at 80°.

Here it will be noticed that 9 spaces of 20° each on the F. will correspond to 5 on the C. and 4 on the R.[9]

[8] Derive the word.

[9] The teacher should draw diagrams of each on the blk. bd., and work out imaginary questions, illustrating the various scales.

THE BAROMETER.

MATTER.

METHOD.

We sometimes hear people say, "The Glass is low." What glass do they mean? The weather glass. Yes; its proper name is **Barometer.** Derive the word in an upper class.

I. Principle explained.[1]

A column of air (which is 45 miles high, the atmosphere extending this distance on all sides of the earth) is equal, in weight, to a column of mercury, 30 inches in height, or of water 33 feet. As these are equal, it follows that one may be placed for the other, and also, that any change affecting the one will also affect the other.

[1] Let this head be made very intelligible before proceeding with the next.

II. Construction.[2]

A glass tube, 3 ft. long, open only at one end. This is filled with mercury; then, having stopped the end with the finger, it is immersed in a cup containing a little mercury. The metal in the tube then descends, leaving a vacuum[3] in the upper part. The atmosphere continues to press on the mercury in the cup, hence that in the tube rises.

This tube is placed (the cup being closed to ensure its safety when moved about,) in a wooden or metal case, provided with a graduated scale, in order to indicate the height of the mercury.

[2] Let the teacher either exhibit a diagram or draw one on the blk. bd.

[3] Called the Torricellian vacuum, from its inventor.

III. Uses.

(1) AS A WEATHER GLASS. The air is *heaviest* in fine weather, and consequently the mercury rises. In bad weather we say "the glass is low."[4]

(2) HEIGHTS OF MOUNTAINS, &c., ARE ASCERTAINED BY IT. The higher one ascends the more rarefied the air becomes; hence the mercury falls.

On the summit of Mont Blanc, which is 15,732 feet high, it sinks to 16 inches.[5]

[4] Dispel the popular delusion on this point, shewing that damp air is really lighter than dry air, but *feels* heavy because it is less salubrious.

[5] Make a calculation on the blk. bd. shewing that the rate of fall is about one inch per 1000 feet.

THE COMMON PUMP.

MATTER.

METHOD.

What have we which enables us to raise water from the well? **A Pump.**

I. Principle explained.[1]

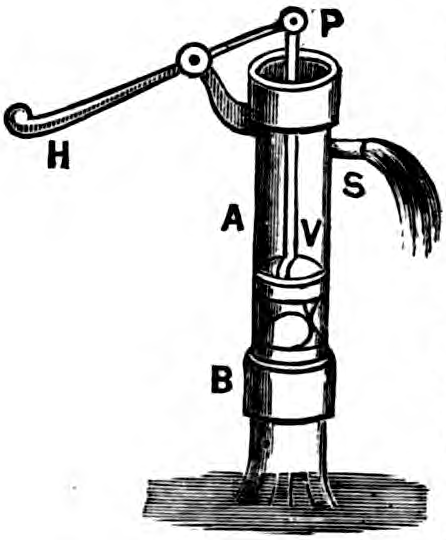
Quicksilver or mercury is supported at a height of 30 inches, by the pressure of the atmosphere; water to the height of 33 ft.; hence the two are equal: therefore if a cubic foot of one weigh twice as much as a cubit foot of the other, the air will support a column of the latter at twice the height of the former.

[1] Dwell upon this head, so as to make it as clear as possible.

II. Construction[2] and action.

A B is the pipe or body of the pump; P, the piston, to which is attached, at the upper extremity, the handle H, and, at the lower, a

[2] The teacher should either exhibit a diagram or draw one on the blk. bd.



bucket, containing V, a valve or little door. This valve opens upwards.[3] It prevents the return of the water, by closing after it has passed through.[4] Y is another valve at the bottom of the body. When the pump is in action, the valves are closed: but when the piston is raised by the lowering of the handle, the air above the piston is raised, and a vacuum produced between it and the lower valve. A few strokes exclude the air from the body of the pump, and the water then rises, and, having passed through both valves, flows out at the spout, S.[5]

REMARKS. The distance from the level of the water in the well to the valve in the piston ought not to exceed 32 ft., otherwise the water would not be sure to rise through that valve, inasmuch as the weight of the atmosphere is sometimes not sufficient to raise the column of water more than 32 feet.[5]

Explain the failure of pumps in dry weather: valves which are made of leather fit loosely; water poured in, they expand, and the pump then acts.

[3] Why? To allow the water to pass through it.

[4] Explain by reference to diagram.

[5] Shew by this explanation that the water is raised to the spout of the pump, because—

(1) A vacuum is produced in the tube, and

(2) The pressure of the atmosphere on the water *outside* the tube causes it to rise in the tube.

These facts will be rendered clear by

(1) A straw tube.
(2) A common squirt.

[5] Shew that this pump is both *sucking and lifting.*

THE DIVING BELL.

MATTER.

I. Principle explained

(1) *Two bodies cannot occupy the same space at the same time.*

Illustrations:—

(*a*) A nail driven into wood *displaces* the wood, and if dropped into water, that also is displaced.

(*b*) A half-pint cup of water would not hold milk if the attempt were made to pour it in.[1]

(2) *The air presses on all objects with which it comes in contact.*

Illustrations:—

(*a*) Fill a wineglass with water, place over it

METHOD.

There is a machine, the object of which is to enable men to recover treasure from the bottom of the sea. It is called **The Diving Bell.**

[1] Ask for one or two other examples:

(*a*) Boy's hand thrust into a pocket full of nuts.

(*b*) Ditto into a basin of water, &c.

a piece of paper; immediately invert it, and the pressure of the atmosphere supports the paper and prevents the flow of the water.

(*b*) The pressure of the atmosphere=15 lbs. to a square inch; thus it presses with a force equal to fourteen tons on the body of an averaged sized man.[2]

It is on these two principles that the diving bell is constructed.

II. Construction of the bell.

Formerly made round, with the bottom larger than the top;[3] latterly, however, the square form has been preferred. Sides of the bell furnished with seats.[4] The top of the bell is provided with strong glasses; these act as skylights.[5] Each bell is also furnished with two pipes, or tubes, communicating from the vessel with the interior of the bell. Pipe No. 1, supplies it with fresh air; No. 2, discharges the foul air.[6]

When everything is ready the men get into the bell, which is then lowered by means of a pulley,[7] over the sides of the vessel, to the bottom of the sea.[8]

III. Dangers to which the divers are exposed.

(*a*) WANT OF AIR. As the depth of 33 ft., water, occupies the lower half and air only the upper half of the bell.[9]

(*b*) UPSETTING OF THE BELL. If not lowered perfectly level it would tilt, and the water flowing in would drown the men.

(*c*) CONDENSATION OF AIR. In time the air would become unfit to breathe were it not replaced by a fresh supply.[10]

(*d*) ATTACKS OF FISH. Sometimes these have overturned the bell: in which case the men have been, at once, drowned.

IV. Uses.

By means of the diving bell.

(1) Canisters of gunpowder have been affixed to sunken vessels, in order to bring them to the surface.[11]

(2) Men fish for oysters.[12] This fishery is prosecuted chiefly in the neighbourhood of Palk's Strait, between India and Ceylon.[13]

REMARKS. The following are examples of the use of the diving bell

[2] Shew how it is we are not crushed; viz., the air within us counterbalances that without. Refer also under (*b*) to the same principle as seen in the barometer and common pump.

[3] Hence its name of "The Diving *Bell*."

[4] What for? The workmen and their tools.

[5] Shew how, and illus. by reference to skylights in houses.

[6] Why must air be pumped in? Exp. (*b*) as above, shewing that the water would in time fill the bell and so drown the men.

[7] Explain: and illustrate by cord of a blind, builders hoisting stone, &c.

[8] How do they know when the bottom is reached? The men in the bell communicate with those above.

[9] Hence the necessity for pumping the air into the bell.

[10] Hence the use of the two pipes already alluded to.

[11] Why? (*a*) Because if the water were rather shallow they would impede navigation. (*b*) In order to obtain the treasure they contain.

[12] Called "pearl" oysters. Shew their value.

[13] Shew on the map.

(*a*) In 1638, Captain Pasley used the diving bell and helmet for the purpose of affixing canisters of gunpowder to the remains of sunken vessels, which impeded the navigation of the Thames.

(*b*) In 1665, some cannon were recovered: they belonged to Spanish vessels; probably part of the Armada, which had been wrecked near Mull,[14] in 1558; 107 years before.

(*c*) In 1687, a man named Phipps, recovered £200,000 on the coast of Spain.

[14] Shew on the map, and briefly refer to the event.

JARROLD AND SONS, PRINTERS, NORWICH.

NEW
EDUCATIONAL PUBLICATIONS.

JARROLDS' PROBLEMATIC TEST CARDS.

By Charles Taylor. Five Sets, at Eightpence per Set of 20 Cards.

Most of the existing sets of Arithmetical Cards were published before the New Code came into operation, and are either much too difficult for all test purposes, or contain no "questions which call upon the child's reasoning powers." [*Vide* Instructions to School Inspectors.]

These CARDS are adapted to the most recent requirements of the Government Examinations, and most of the sums have been actually set in Examinations by Her Majesty's Inspectors.

THE "ECLECTIC" ARITHMETIC.

Part I. Price One Penny.

By C. TAYLOR, Author of the "Problematic Test Cards." The "Eclectic" Arithmetic is published in Five Parts, adapted to every class of School.

JARROLDS' SIXPENNY READABLE ATLAS.

Sixteen Beautifully Coloured Maps.

The recommendation of this Atlas is the Distinctness of the Outline Colouring, and the Clearness of the Lettering.

LESSONS IN ENGLISH GRAMMAR

By James Ford. Price 1d.

JARROLDS' EDUCATIONAL SERIES FOR SCHOOL AND HOME. Part I. THE PARTS OF SPEECH. With numerous Questions and Exercises after each Lesson.

ELEMENTARY DRAWING.

By Alfred Copham.

A NEW SERIES OF READY HELPS TO FREEHAND AND MODEL DRAWING. Carefully Graduated for the Use of Beginners.

No. 1. Freehand. Price 2*d.* No. 2. Freehand. Price 2*d.*
No. 3. Model. Price 2*d.*

LONDON: JARROLD & SONS, 3, PATERNOSTER BUILDINGS.

Jarrold & Sons' Educational Books.

ELEMENTARY.

Child's Pathway Through the History of England: in Question and Answer. With Heads of the Sovereigns. 6d.

Learning to Read: First Book for Children. Cloth back, 6d.

First Grade in Learning to Read: Interesting Narratives in Prose and Poetry, with Lessons in Script. Cloth back, 2d.

Second Grade in Learning to Read: more advanced Lessons. Interesting Narratives in Prose and Poetry, with Lessons in Script. Illustrated. Price 4d.

Third Grade in Learning to Read; on the same plan. Illustrated. 6d., cloth.

Learning to Spell. One Penny.

Bond's Child's Question Book of Useful Knowledge. 18mo, stiff cover, 9d.; or cloth, 1s.

Martin's Intellectual Primer; or, First Book for the Young. Numerous Illustrations. 12mo, embossed cloth, 1s.

Martin's Intellectual Spelling Book; containing the Correct Spelling and Pronunciation of Ten Thousand Words. Cloth, 1s.

Martin's Intellectual Expositor; the Meanings of Five Thousand Words, with Tables of Prefixes, Affixes, &c. Cloth, 1s.

Lyrics for Little Ones. Cloth, 1s.

School-Room Poetry. Thick 18mo, cloth, 1s. 6d.

The Children's Hosannah: 129 Hymns for Schools. 1d.

The Class Singing-Book; a complete System of Instruction in Singing. By Henry Rudd. 8vo, stiff cover, 1s. 6d.

HISTORY.

Dr. Brewer's Allison's Guide to English History and Biography; from the Invasion of Julius Cæsar to the year 1863. Cloth, 3s.

A Reading Book of English History and Biography. By the Rev. W. Legge. With Examination Questions. Cloth, 2s. 6d.

Dr. Brewer's History of France; Social, Political, and Literary, brought down to the year 1863. Embossed cloth, 5s.

Dr. Brewer's Smaller History of France. In Question and Answer. Embossed cloth, 2s. 6d.

Dr. Brewer's Guide to Roman History and Biography: from the Earliest Period to the Close of the Western Empire. Cloth, 3s. 6d.

Dr. Brewer's Guide to Grecian History, Mythology, and Literature. Embossed cloth, 3s. 6d.

Compendium of Universal History; comprising

A COMPENDIUM of ANCIENT HISTORY. 9d.; embossed cloth, 1s.
THE MIDDLE AGES. 9d; embossed cloth, 1s.
MODERN HISTORY, 9d.; embossed cloth, 1s.
HISTORICAL QUESTIONS on the 3 preceding Books. 9d.; cloth, 1s.

The FOUR in one handsome volume, embossed cloth 3s. 6d.

HISTORY *(continued)*.

Dr. Brewer's Smaller History of France. In Question and Answer. Cloth, 2s. 6d.

Dr. Brewer's Guide to Roman History and Biography: from the Earliest Period to the Close of the Western Empire. 3s. 6d.

Dr. Brewer's Guide to Grecian History, Mythology, and Literature. Embossed cloth, 3s. 6d.

Farr's Illustrated Manual of Geography: Physical and Political. Cloth, 2s.

Compendium of Universal History; comprising the following Four Divisions:—

A COMPENDIUM of ANCIENT HISTORY. 9d. Embd. cloth, 1s.
THE MIDDLE AGES. 9d. Embossed cloth, 1s.
MODERN HISTORY. 9d. Embossed cloth, 1s.
HISTORICAL QUESTIONS on the Three preceding Books. 9d. Embossed cloth, 1s.
The Four in one handsome vol., embossed cloth, 3s. 6d.

SCRIPTURE HISTORY.

Dr. Brewer's Guides to Scripture History:

The OLD TESTAMENT, with Contemporaneous History. 3s. 6d.
The NEW TESTAMENT, with Contemporaneous History, and the Political and Religious Aspect of the Period. 3s. 6d.

Two Thousand Questions on the Old and New Testaments: With Explanatory Introductions to each Book, a concise History of the Jews, and Sketch of the Christian Evidences. Cloth, 2s.
THE KEY, cloth, 2s.
ONE THOUSAND QUESTIONS ON THE OLD TESTAMENT.
ONE THOUSAND QUESTIONS ON THE NEW TESTAMENT.
Being the separate parts of the above Work, price 9d. each, stiff cover; 1s. cloth. KEY to each, 9d.

The Child's Pathway Through Bible and Gospel History. By Mrs. R. Barker, Author of "The Land of Promise," etc. 6d.

Bible Stories. By Lucy Barton. New Edition, steel Frontispiece, 18mo, cloth, 1s.

Questions and Answers on the Prophecies Concerning our Lord Jesus Christ. 2d.

SCIENCE.

Dr. Brewer's Theology in Science; a complete Treatise on GEOLOGY, PHYSICAL GEOGRAPHY, ETHNOLOGY, or the Species of Man; PHILOLOGY, or the Languages of Man, etc. Cloth, 3s. 6d.

Dr. Brewer's Guide to Science. **105th** Thousand. Embossed cloth, 3s. 6d.

Vegetable and Animal Life: a Hand-Book of Physiological Science. By Dr. Mann. Illustrations, cloth, 3s. 6d.

BOOKS FOR PRIZES & PRESENTS.

ONE SHILLING BOOKS.

Happy Half-Hours with the Bible; or, Mary Jane and Bertie. By Aunt Emily. Frontispiece, 18mo, cloth.

My Teacher's Gift. For Girls. On Toned Paper, with Frontispiece. 18mo, cloth. Also in Paper Covers, 6d.

My Teacher's Gift. For Boys. On Toned Paper, with Frontispiece. 18mo, cloth. Also in Paper Covers, 6d.

Consideration; or, How we can Help one Another. By Emma Marshall. Frontispiece, 18mo, cloth.

Children of Summerbrook: Scenes of Village Life in Simple Verse. By Mrs. Sewell, Author of "Mother's Last Words." Frontispiece, 12mo, cloth.

Rose Bryant: Passages in her Maiden and Married Life. By Emma Marshall. Frontispiece, 12mo, cloth.

The New Home: or, Wedded Life; its Duties, Cares. and Pleasures. Frontispiece, 12mo, cloth.

The Peace Maker and the Mischief Maker. Frontispiece.

Tales of the Workroom:—The Sisters. By Mrs. Curtis. Frontispiece, 18mo, cloth.

Lessons about God: for very Little Children. By Sophia Sinnett. Embossed cloth.

Lyrics for Little Ones. 18mo, cloth.

Bible Stories. By Lucy Barton. New Edition.

Katie's Work. By Emma Marshall. Frontispiece, 18mo.

Things of Every-day Use: What they Are, Where they Come from, and How they are Made. 12mo, cloth.

Kirton's Temperance Tales, including "Buy your own Cherries." 12mo.

The Rose of Cheriton. A New Ballad, by Mrs. Sewell. Also in Paper Covers, 6d.

Homely Ballads; for the Working-Man's Fireside. By Mrs. Sewell.

Stories in Verse: a Second Series of Homely Ballads. By Mrs. Sewell.

One Shilling and Sixpence each.

Roger's Apprenticeship; or, Five Years of a Boy's Life. By Emma Marshall. 8vo, foolscap, embossed cloth

Fred Williams. A Tale for Boys. Frontispiece, cloth

Sayings about Friendship. By the Author of "Do it with Thy Might." Embossed cloth

Rural Scenes; a Peep into the Country. New Edition, profusely illustrated, demy 18mo, embossed cloth

Picture Story Book of London; or City Scenes. New Edition, profusely Illustrated, royal 18mo, embossed cloth

The Earth and its Garment of Water and Air. 12mo, cloth

The Atoms and Electric Forces of the Earth. 12mo, cloth

Hints on Self-Help for Young Women. By Jessie Boucherett. Frontispiece, 18mo, cloth

Do it with Thy Might; or, our Work in the World. Addressed to those who ask, "What shall we do?" Cloth elegant

Health for the Household. Cloth. Frontispiece.

Here a Little and There a Little; or, Daily Manna for the Lambs of Christ's Fold. By a Mother. Frontispiece, 18mo, cloth

The Life of a Plant; "Science for the Household." Cloth

Household Truths for Young Men. Cloth. Frontispiece.

Household Truths for Working Men. Cloth. Frontispiece.

Household Truths for Mothers and Daughters. Cloth. Ditto.

Two Shillings each.

Our World; its Rocks and Fossils. By the Author of "The Observing Eye," &c. Numerous Illustrations, 12mo, cloth

Caterpillars, Butterflies, and Moths; their Manners, Habits, and Transformations. By M. and E. Kirby. Illustrations, cloth

The Illustrated Geology; or, Former Worlds, their Structure, Condition, & Inhabitants. By F. C. Bakewell. Illustrations, cloth

Patience Hart's First Experience in Service. By Mrs. Sewell, Author of "Mother's Last Words," &c. Foolscap, 8vo, cloth

The Mother's Manual for the Training of her Children. By Mrs. Reed; with a Preface by her Sons, the Authors of "The Life of Dr. Andrew Reed." With Frontispiece

HOUSEHOLD TRACTS

FOR THE PEOPLE,

Supply information on Health, Home Happiness, Training up Children, and Social Morals, in the most interesting and attractive style of narrative and illustration. They are eagerly read by young and old of every station. **THREE MILLIONS OF COPIES** are already in circulation.

FOR MOTHERS.

Cottage Homes.
The Mother's Trials and Triumphs
Sick Child's Cry; Household Verses
The Good Mother.

FOR PARENTS.

How do you Manage the Young Ones?
How to Make the Most of Things.
Peace in the Household.
Household Management.
Whose Fault is it?
Never Despair! Household Verses.
Something Homely.
Household Troubles; How to Meet Them.

FOR WORKING MEN.

When to Say "No!"
Working-Men's Hindrances.
The Day of Rest.

FOR YOUNG MEN.

Young Men in Great Cities.
How to Take Care of Number One.
How to Rise in the World.
Life's Battles.
Men who have Fallen.
Company.

FOR YOUNG MEN & WOMEN.

Are you Thinking of Getting Married?
Going-a-Courting, etc.
Marriage Bells.

FOR SERVANTS.

My First Place.
Kind Words for the Kitchen.

FOR GIRLS.

The Happy Life.
Daughters from Home.
The Dangerous Way.

FOR BOYS.

The Starting in Life.
How to "Get On" in Life.

FOR CHILDREN.

Mother's Last Words.
Household Rhymes.
Work & Play: Household Verses.
Village Children at Home.
Village Children at School.
The Happy Schoolfellows.
Dear Children.

FOR SAILORS.

A Short Yarn.

FOR EVERYBODY.

Our Father's Care.
Straightforwardness, &c.
Scandal, Gossip, Tittle-Tattle, &c.
Temptation.
The Gain of a Well-Trained Mind.
Kind Turns.
A Picture from the World's History.
Perils in the Mine.
A Tale of a Dark Alley.
Sunday Excursions.
What shall I do with my Money?
Margery, the Martyr.
Home, Sweet Home.
Lost Days.

ON HEALTH.

The Worth of Fresh Air.
The Use of Pure Water.
The Value of Good Food.
The Influence of Wholesome Drink.
The Advantage of Warm Clothing.
How do People Hasten Death?
Secret of a Healthy Home.
How to Nurse the Sick.
How to Manage a Baby.
The Health of Mothers.
The Black Ditch.

Twopence each; or in 10 assorted Packets, 1s. each Pkt.