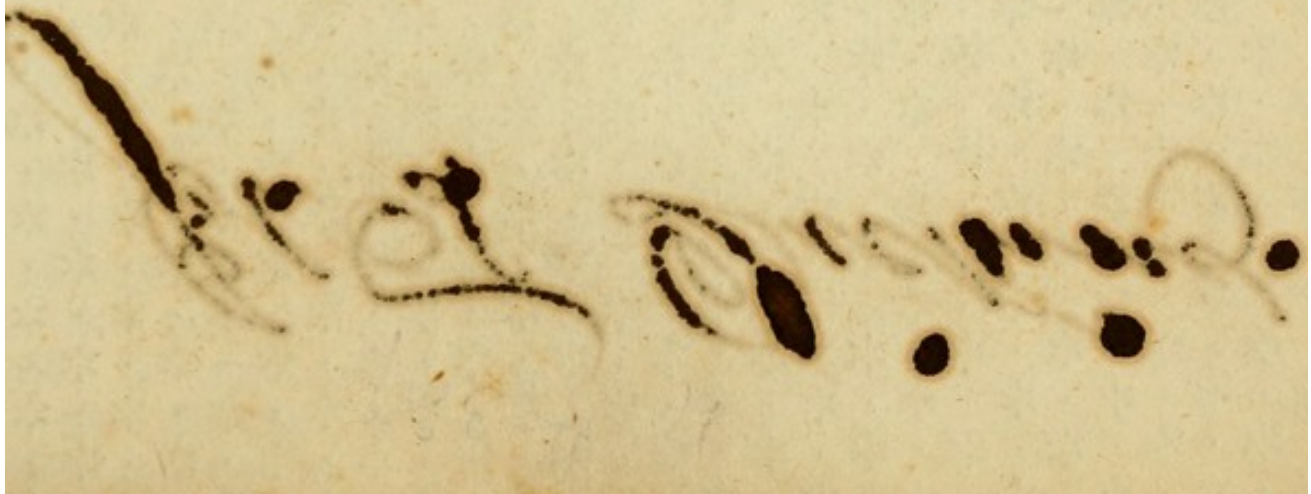
Familiar lessons on physiology : designed for the use of children and youth in schools and families / by Mrs. L.N. Fowler.



FAMILIAR LESSONS

ON

PHYSIOLOGY AND PHRENOLOGY,

FOR

CHILDREN AND YOUTH.

IN TWO VOLUMES.

FAMILIAR LESSONS

ON

PHYSIOLOGY,

DESIGNED FOR THE USE OF

CHILDREN AND YOUTH

IN

SCHOOLS AND FAMILIES.

ILLUSTRATED BY NUMEROUS ENGRAVINGS.

BY MRS. L. N. FOWLER.

CHILDREN—OUR FUTURE MOTHERS, JUDGES, STATESMEN.

VOL. I.

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PREFACE.

TO PARENTS AND TEACHERS:—

Children are generally ignorant of the simplest laws which relate to their bodies, and to the functions of their minds. They are sent to school it is true, but are seldom instructed in these things there; and it is too often the case that they grow to maturity with habits which undermine their health, and bring them to an early grave; which might have been avoided if they had received proper instruction in early life.

That it is *important* for children "to know themselves," mentally and physically, is self-evident to every reflecting mind, and *this* being admitted, the most direct means should be used to accomplish this object. A correct knowledge of the laws and principles of Physiology and Phrenology is undoubtedly the most effectual medium through which this light can be obtained, and should, therefore, be extensively diffused and disseminated.

The design of these two volumes, is, to present these subjects in a clear and familiar manner, to explain their general laws, to illustrate them by cuts and familiar examples, such as occur in every-day life, to impress the truths inculcated on the conscience, so that children may not only feel their importance, and that it is their duty to obey the laws of their being, but that they may also feel that they have responsibilities, from which they cannot free themselves. I have affixed questions to each page for a two-fold purpose, namely, to enable teachers and parents to ascertain how far and how much the principles have been understood by them, and also to impress these principles deeply on their minds.

As the truths of Phrenology and Physiology are fully established in other works, I have drawn my inferences and conclusions from premises which I have not deemed it necessary to prove. I have written in a colloquial style, and have studied simplicity; yet I think that in addressing children we should not always adhere strictly to this; for while they learn and repeat, when very young, long and unmeaning expressions, it is time to speak to them of words which convey *instruction* as well as *sound*.

A child can comprehend that the petals of a flower are its leaves, and that the cuticle is the outer membrane of the first skin.

The opinion that a knowledge of the mind, its laws and functions, should, and must of necessity, be confined to the Stoic, the Philosopher, and the Sage, has prevailed too long in society. The mind of man is but a development of the elements of his nature, and these elements can be understood by children.

Said a reverend gentlemen when speaking of little children,—"Here is the replenishing of the world, here is a new wave of existence. From these little children will be selected our future rulers and judges of the next half century." Another talented and eloquent writer also said—"What a magazine of energies is a little child. How many journeys across continents, if need be, on errands of mercy, may be snugly packed away in those little feet. From between that little right thumb and finger, what volumes may yet flow out—poetry, history, philosophy, ethics, etc.!"

Parents and teachers, the minds of children are placed in your hands to mould and direct! They have, as all *must* allow, *natural* tendencies of mind, *natural* propensities, *natural* predispositions; yet they are not "*fated*" to act *only* as these dictate; but they *can* be so trained, cultivated, or restrained, that their influence is often greatly modified or entirely counterbalanced. Will you train them for usefulness and happiness; or will you suffer the tares of ignorance and vice to grow and expand in their little minds, till they eventually root out all the good? It is for *you* to say. The responsibility rests on *you*. Do not, therefore, for the love you bear your little ones—"those links between angels and men"—neglect your duty to them.

That these volumes may serve, in some degree, as a pilot to enable children to avoid the shoals and quicksands of life, is the sincere wish of their friend,

L. F. F.

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PHYSIOLOGY FOR CHILDREN.

CHAPTER I.

DIGESTION.

1. Children, I wish to converse with you for a little while, if you will be very attentive, and listen to me. You know what I mean, I suppose, by conversing? for you all talk and chatter from morning till night, frequently to the great trouble and annoyance of your friends and parents. Conversing is to talk.

2. *You* are the talkers then; generally you do all the conversing; but, at the present time, *I* wish to do most of the talking myself.

3. Did you ever hear, children, of Physiology and Phrenology?

"No," responded little Clara, "*I* never did."

Clara, do you like to be sick? Do you like to have your head and body filled with pain, and to be obliged to lie on your bed all day long?

"Oh, no," she answered quickly.

4. Well, children, when I say I will tell you what Physiology is, I mean that I shall explain to you why it is that we are sometimes sick—why it is that we can walk. I shall tell you about the bones, the teeth, the skin; what it is that makes our bodies increase in size;

What is the subject of Chapter first? 1. How do children frequently annoy their parents? 2. Who generally does the chief of the talking? 3. Is it pleasant to be sick? 4. What do we learn by means of Physiology?

besides many other interesting things that you will be very glad to know.

5. When you purchase a toy, you are very anxious to know why it will make a noise by turning a crank, or why the little china dog will bark, or the wooden milk-maid churn. You are sometimes so inquisitive about these things, that you often pull very handsome toys to pieces to see what it is that seems to give them life and motion.

6. I am always pleased to see your desire to obtain knowledge; but children frequently ask a great many questions about things improper for them to know. I wish you to ask as many questions as you now do; but I wish you to think more about your bodies—why it is that we eat every day, and why it is that we grow; why it is that when we cut our fingers they get well again, as we say; or, in other words, that Physiology is the study of the living animal. A knowledge of these things will make you both happier and better children, and men, and women. Shall I tell you about them?

7. The sparkling of Clara's bright eyes showed that *she* was filled with anxiety to know.

"Tell us, do tell us," responded these little ones, "we will all be very silent, and try to understand what you say."

8. Well, rejoined I, one day I overheard two little boys, Charles and David, talking together. Charles said to David, "Is it not very strange that I am a larger boy than I was last year? Mother told me that if I were a good boy, and went to bed when she wished me

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5. Why do children frequently destroy their toys? 6. What kind of curiosity should be encouraged in children? 7. Can anything be learned by the expression of the eyes? 8. How did Charles account to David for his growing larger?

to go, without crying, that I should be a man if I lived long enough. So I have gone to bed ever since, and have tried to be good, that I might grow as large as my father."

9. "No," said David, "we grow if we do not cry when we have to take medicine; for old nurse told me 'that I could never be a large man in the world' if I cried and did not take the bitter stuff she had prepared for me. She said if I *did* cry, she would smooth down my face with a hot iron; and I had half a mind to let her do it, to see if that would not make my face larger and longer. "So in this way these two boys went on talking, and although they appeared very intelligent, and had attended school several years, they did not know the simple laws of their own bodies.

10. I wish all the children who hear my instructions to know that such things are foolish and untrue. I wish you to know that you have a heart, lungs, and stomach; and also to know for what purpose they were given to you, and the service they are to you. I will imagine some of your thoughts and questions, and will try to interest and instruct you.

11. You all go to the table one, two, and three times every day, and what do you do when you are there?

Why, I eat; yes, I eat just as hard and as fast as I can, says William; and I carry something to school beside to eat if I can get it.

12. William, what do you eat for?

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9. How did David account for *his* growing larger? Do children learn about their bodies by attending school? 10. Had Charles and David correct ideas about their growth? What thing ought all children to understand? 11. What do children do when at the table? 12. Why do children eat?

"Why," said William, "because I am hungry, to be sure; and I can scarcely wait to come to the table."

That is right, William; but what becomes of your bread, and butter, and cheese, and apples?

William could not answer a word; but Alfred instantly replied, "My mother says, that what we eat makes us grow; but how I cannot tell."

13. Here are William, and Alfred, and Sarah, and Jane, and a great many more children, who are eating, eating all they can get, and yet they do not even think whether it does them any good or not, or in what way it benefits them.

14. But, children, our food makes blood, and our blood increases our size. Now let us examine this curious subject for a few moments, and see how it is done. You have probably been at a mill where corn, wheat, and other grain, were ground into flour and meal. For this purpose, they have large stones, which, by turning round, cut the kernels of corn, and press them very fine. We have also something prepared to grind our food.

15. We have teeth, sharp and strong, with which to chew our food, and there are also in the mouth little vessels called glands, that contain a fluid like water, which is called saliva. This moistens the food, the same as a cracker becomes soft when put into water. This saliva is called by boys and girls who do not know any better, spittle.

16. If this saliva did not exist, the mouth would soon

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12. Could William tell what became of his food? What was Alfred's reply? 13. Do children generally think why they eat? 14. Why do we eat? How and where is grain ground? 15. With what do we chew our food? What do the glands in the mouth contain? How does the saliva act? What is this saliva sometimes called? 16. Is this saliva of any use in the mouth?

become very dry and parched. In the back part of the mouth, there are three passages: one which leads into the nose or nostril; one into the wind-pipe, through which we breathe; and the third, which is called the gullet or œsophagus, goes down into the stomach. The latter is the one through which we wish the food to pass. But how do we know that it will take the right course? for if it should pass down either of the other ways, the person would not be able to breathe, and would soon become sick, and perhaps die.

17. Listen, and I will tell you how it is prevented from going wrong. There is a little piece of flesh at the root of the tongue which moves upward and downward, called a valve or trap-door, which shuts down over the wind-pipe when we swallow, just like the cover to a book or box, and fits so nicely that the food passes along down the throat, until it reaches the stomach.

18. The following cut represents the stomach, which is shaped like a bag, and usually contains about two or three pints in an adult or full-grown person. It is capable of being contracted or extended, as the case may require. The letter C is the tube through which the food passes, called the cardiac orifice. The letter P shows the outward passage, which is called the pylorus or "door-keeper," as it prevents the food from passing out until it is properly digested, and also prevents it from returning after it has been sent out. I shall give you only a few hard names, and these I wish you to remember.

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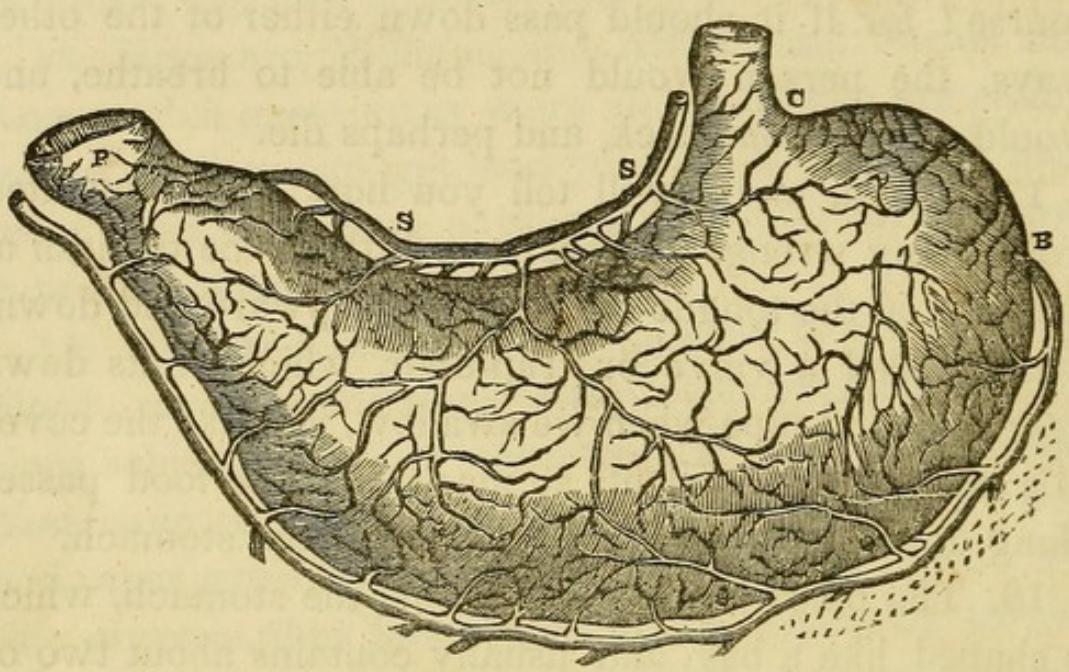
16. What passages are in the back part of the mouth? Through which does the food pass? What would be the consequence if it should take either of the other passages? 17. How is it prevented from taking a wrong course? 18. Describe the stomach. How much does it usually contain?

19. The stomach is situated on the left side of the body, under the ribs, and has three coats or coverings. The stomach has also a fluid resembling that in the mouth, called the gastric juice, which mixes with the outside portion of the food, making it into a soft substance called chyme. All the water that we drink is



THE STOMACH.

taken up by the veins of the stomach, and is absorbed in about three minutes. It is for this reason, that, when a person has fasted, or has not taken food for some length of time, he derives nourishment quicker from drinking than from eating, because the water is soon sent all over his body. Many ignorant persons suppose that there is one passage to the stomach for all the water which we drink, and another for all the food which we eat.

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19. Where is the stomach situated? What fluid does the stomach contain? How is chyme made? What becomes of the water which we drink? Why does a person derive nourishment from water quicker than from food? What idea do many persons have in reference to eating and drinking?

20. Dr. Wieting, an interesting lecturer on Physiology, tells an amusing story of an ignorant Irishman, who began to think about eating and drinking, but who, becoming puzzled, went to a physician, and asked him whether indeed there were two passages to the stomach, one for the solids and the other for liquids. The doctor replied that there was only one.

"Well," said he, "I thought they must be wide awake down there to separate the puddin' from the milk when I ate them."

21. If the nerves that lead from the stomach to the brain were cut off, the sensations of hunger and thirst which we all feel, would be destroyed. After the chyme has been formed, it passes out of the stomach through the pylorus into the duodenum, or second stomach, as it is sometimes called, which is the upper part of the intestines. As soon as one portion of the food is sent out of the stomach, another portion is formed into chyme, and so on, till all has been mixed with the gastric juice, which soon takes place, unless we have eaten too much food, or that of an improper kind.

22. The chyme which is prevented from returning to the stomach by a little valve in the pylorus, is now mixed with the bile that is secreted by the liver, which lies at the right side of the stomach, and a juice called the pancreatic, which comes from the pancreas, situated near the stomach. These two fluids convert it into a white fluid called chyle. It now travels along over the

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20. Relate the anecdote of the Irishman. 21. What effect have the nerves on the stomach? How is the whole of the food converted into chyme? What prevents the return of the chyme to the stomach? Where are the liver and the pancreas situated? How is chyle made? Over what does the chyle pass?

whole internal surface of the intestines, which are six times the length of the body, but are folded in so compact a manner that they occupy but a small space.

23. As the chyle is passing, that part of it which will make good blood, or is fit for the growth and nourishment of the body, is taken up by thousands of little tubes, called lacteals—because the fluid is white—also called capillary vessels—because the Latin word capilla means a hair—and these tubes are as small as a hair. It travels along through these tubes in the same manner that the particles of oil travel along through the little tubes in the wick of a lamp, till they unite in larger tubes.

24. These terminate in glands, from which larger tubes or pipes collect and carry the chyle from all parts into one common vessel, called the receptacle or thoracic duct, which holds about a table spoonful. From this bag a large pipe proceeds, which runs up the back part of the chest, and along till it reaches the neck at the top of the left shoulder.

25. It is now poured into a large vein called the subclavian vein, which carries the chyle, together with the old blood coming from the veins, situated all over the body, to the heart, the great fountain of life. The blood, now formed, runs along, being of a dark color, but which is not yet healthy, to the lungs. Here the air we inhale or breathe in, changes the dark color of the blood to red, as we see it when we prick our fingers.

26. Then it flows back to the heart, and by a con-

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23. What are the lacteals, and what is their office? In what manner does the chyle pass through them? 24. Explain the further passage of the chyle. 25. How does the chyle and old blood finally reach the heart? Where does this blood run, and what change takes place in it?

traction of the muscles of the heart, it is thrown into tubes, called arteries, with sufficient force and rapidity to carry it to all parts of the body.

27. The blood contains the elements of all those substances which compose our body. It is the blood which makes our bones, our skin, our hair, and every limb; and it is the blood which makes us grow. So you see if we did not eat, we should not have any blood, and so of course we could not grow.

28. You may think it very strange that the red blood flowing like the water in a river, can make something as hard as a bone or flesh. But when you cut your finger, or break a bone, the reason why, after several days or weeks, it heals or becomes well, is, that the blood, in passing the place cut, leaves a little something there; the next time it leaves again a little substance; when, by and by, it becomes flesh and skin.

29. When a bone is broken, just the same process goes on, only the substance left is a little harder till a piece of bone is formed. Should you hurt your finger-nail so that it peeled off, you would find that gradually a new nail would grow, but if you should eat very sparingly for two or three months, you would not see this growth.

30. Different kinds of food make different quantities of chyle and different kinds of blood. Animal substances make more chyle than vegetable; hence, if we lived altogether on meat and animal food, we should not require so much in quantity.

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26. What is said of the blood after it flows back to the heart? 27. What does the blood contain? 28. Explain in what manner the finger heals when cut? 29. Explain in what manner the bone unites when it is broken? 30. On what does the quality of the blood depend?

31. Men, women, and children eat a great many kinds of food which are very injurious. Some people drink rum, wine, and other ardent spirits, although they are sensible that these only heat the body, do them great injury, and render them more stupid than the beasts who have no reason to guide them. They make no blood at all, but burn the stomach till it is all consumed. Tea and coffee make poor blood; so do all kinds of spices and rich gravies.

32. In the mill I spoke of, supposing those who had the care of it should throw in corn all day, without stopping to see whether the mill was full or not, do you not suppose they would soon get the mill out of order, so that they could not use it at all? But our stomachs are much more delicate, and more easily injured by our eating too fast, too much, and too often, than the mill.

33. When Nature does anything, she is governed by regular rules and fixed laws, and is systematic in all her arrangements. She does one thing at a time, and is only capable of doing a certain amount, and no more, without injuring some other part or function of the body.

34. Suppose I should listen to the talking of the stomach, what do you think it would tell me? I will imagine it to be William's stomach. As soon as he awoke in the morning, and was dressed, he teased his mother for something to eat, for he was very hungry; his mother, to get rid of his importunities, said, "Yes," and gave him a large slice of bread and butter. By and by, in the course of a few moments, the stomach heard

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31. What are some of the things that make poor blood? 32 How could a mill be injured? How are our stomachs injured? 33. What are the operations of nature? 34. Explain what the stomach of William said?

the bread and butter knocking for entrance; so she took it and says, "This will make some nice blood, only it would have been better for my little master if there had not been quite so much butter."

35. So the stomach went on with her work to make it very fine, and get it ready to send to the heart; but before it could quite send it all out, William's mother had prepared his breakfast, and there was another tap at the door: "Let me come in," said some bread and butter; "and me too," says some coffee; "and me also," said a large piece of mince-pie; all of which had been swallowed, half chewed, almost as quick as I can speak, or you can read or hear.

36. "Well," said the accommodating stomach, "I will do all I can for you; but if you had waited an hour, or my master had ground you with his teeth, I could have done better;" but she went to work pushing, and tugging, and throwing her sides together, to get the contents all digested, as it is called, or thoroughly dissolved by that gastric juice which I told you was in the stomach.

37. She almost gave up the undertaking, but she tried again, and finally succeeded in making the chyme. "There," said the stomach, "go; but I am afraid my little master's cheeks will not appear as rosy and bright; for that mince-pie will steal away some of the color from the blood which goes to his cheeks; I really hope that my poor sides will be able to take a little rest.

38. "Little Willy will have to go to school, and will not be able to get any more food till noon." If Mrs. Stomach could have looked into her master's pockets,

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35. What did she do with his bread and butter? 36. How did the stomach succeed with her task? 37. How did the stomach console herself?

she would have groaned most pitifully, and have had just cause for complaint; for he did not wish to go to school that day, and his mother, to pacify him, and make him willing to go, gave him some candy, and some chestnuts, and that large red apple which he had wished for a long time.

39. As soon as the little fellow had wiped away his tears, he started off to school. Recess came. He then put his hand into his pocket for his apple, which he nibbled, and nibbled, till it was all gone; then came his candy, which he thought was very good. "Ah!" sighed his stomach, "what shall I do? I cannot possibly get rid of all this apple, and candy, and so I must let it remain here, till I take a nap to rest me;" but she could not sleep much, for the chestnuts came rattling down, one after another, and asked admittance.

40. Soon school was done, and William ran home; but for some cause he did not feel as happy and comfortable as he did in the morning. *He* said it was because he had been compelled to go to school, and could not play at home

In a short time dinner came on to the table, and William of course took his seat by the side of his father.

41. He must eat because he generally does: so away goes a slice of beef, then some potato, and a great many other things, into his stomach; but she had not sent away all his apples and nuts—so she could not help grumbling and getting out of patience, and declared that she *would not* take anything else.

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38. What would the stomach have seen could she have looked into Willy's pocket? 39. What did she do with his apples, etc.? 40. What were William's feelings, and to what did he attribute them? 41. What took place at the table?

42. This made William feel so uncomfortable that he could not hold his head up, but had to go and lie down on the bed. When his mother went to him he was so hot and feverish, that she sent for the doctor to come and see her poor boy, and said she was sorry that she urged him to go to school; for now he was sick. She did not once think that her sympathy should extend to his poor stomach, which she had assisted in so unmercifully stuffing, and which in return had caused her little William's sickness.

43. The doctor came, and at once told her what the matter was with the boy. *He* took pity on the stomach, and gave the boy some medicine, which caused him to throw up what was not needed, and what could not be properly digested; and said he must take only light nourishment for several days.

44. As I was talking thus, William, who sat by my side, blushed and seemed confused, as if he had done something wrong. Said he, "How did you hear *my* stomach speak the other day? It is very wonderful; but I will not make it feel so bad again."

45. Children, you know that the stomach cannot *talk* or *think*, although it can *feel;* but this is what it *would* say a great many times if it *could;* and I merely supposed this circumstance, to teach you the following important lessons, which you must not forget:

1. That you must not eat in haste.
2. That you must chew your food fine.
3. That you must not eat after your regular meals.

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42. To whom did Willy's mother's sympathy extend? 43. What was the doctor's prescription? 44. What effect did this story have on William? 45. Can the stomach talk? What can it do? What five important lessons should be remembered?

4. That water and simple food are better for the blood than tea, coffee, and all kinds of spices and rich food.

5. That you must eat all your candy, apples, and nuts when at the table; for the stomach cannot digest your food properly under four or five hours, any more than a boy could learn his lesson if his playmate should disturb him, or in any way attract his attention while he was studying.

46. Remember, children, that our stomach is one of the most industrious and important organs in our whole bodies. If this be affected, our whole bodies are affected. We may injure our arm, and still be able to walk, to think, and talk; the same may be true with regard to a leg or foot; but if the stomach be sick, we can neither walk, run, nor use our limbs, and sometimes cannot even think. It is always performing its duties faithfully, whether we are eating, sleeping, or walking.

47. Let us, then, treat this organ with the regard and respect it deserves; let us be careful to eat nothing that shall have a tendency to injure us, or make us sick and unhappy; for, without health, our comfort and enjoyment are both shortened or destroyed in a great degree. Is it right when physicians tell us that only one drop of the oil of tobacco, put on the tongue of a dog, will kill him in three minutes, to learn to *love* to eat the noxious weed in a milder form? You must *never learn* to chew, or smoke, or take snuff. You have not habits formed now, and I do hope that no bright-eyed little boy will be so disrespectful to his stomach as to introduce

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46. What effect does the sickness of stomach have on the other organs?
47. How should we treat our stomachs? What habits should children never learn? What is one great reason that tobacco should not be used?

to her acquaintance this filthy weed; for those who use it are daily losing that saliva which ought to be saved for the mastication of their food.

48. Man has only one stomach, and this is all he needs in the digestion of his food, and in preparing it for blood; but we see that different animals require and have different stomachs: some two, three, or four, as the occasion may require.

49. Lobsters and crabs have a very singular stomach. Near the lower end of it there are five little teeth placed on the opposite side; and these being moved up and down by muscles belonging to them, grind the food passed between them, which then goes out at the orifice or opening, into the intestines.

Some birds have two stomachs. The camel, ox, and other animals of that class, have four stomachs; they usually feed on grass and other vegetables, which they slightly chew, and it is carried into the paunch or first stomach; it here undergoes but little change, when it is sent into the second, which is arranged like little cells, having little divisions or partitions between them.

50. Here the food is divided into little rolls, which are carried to the mouth to be masticated; after which, they are then swallowed, and pass into the third stomach; this has long folds or membranes, where another change is affected, when it passes into the fourth stomach, where the principal work of digestion is carried on, and where the gastric juice flows to act on the food. The food is formed into chyme in the fourth

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48. How many stomachs has man? 49. Describe the stomach of a crab or lobster? How many stomachs have some birds? How many stomachs has the camel? 49–50. How is their chyme made?

stomach, and this process goes on till all the food has been brought in contact with the gastric juice.

51. Remember, when you hear about animals "*chewing their cud*," it is the food which has been swallowed once, and is sent up into the mouth from the second stomach. These animals are called ruminating animals. In the stomach of camels the number of cells is great; and they are very large, capable of holding a quantity of water, which he can force up into his mouth as often as necessary. The camel can travel many days over the sandy desert, where there are no wells of water, on account of this provision that nature has given to him to supply himself before he sets out on a journey.

52. In plants, nourishment is absorbed from the earth by the roots, or from the air by the leaves, which serve as lungs to them. But I must pass to another part of this subject, and will give you a few ideas on digestion.

53. By this, is meant the dissolving or changing of the food after it has been chewed or masticated. All agree that this process goes on in the stomach, but there were formerly a great many different opinions as to the manner in which it was effected.

54. The opinion that is now received, is, that the stomach secretes a gastric juice, which acts on the food, and dissolves it into chyme; which is easily done, if the food has been chewed or masticated sufficiently. When food enters the stomach, the gastric juice flows to every part of it; but if we overload this organ, it

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50. Which stomach contains the gastric juice? 51. What is meant by "chewing the cud?" What are those animals called that "chew their cud?" How is the camel enabled to travel in the deserts? 52. How are plants nourished? 53. What is digestion? 54. What opinion is now received concerning it?

loses its power of producing the fluid, which differs in different animals, according as they differ in their food. The organs of digestion differ in different animals that live on different kinds of food.

55. If you regard these simple rules I have given to you, you will not have as many pains and aches, and will be far happier than if you neglect them.

I will next tell you about the bones, the skin, and perhaps the lungs and heart, if I find your interest continues.

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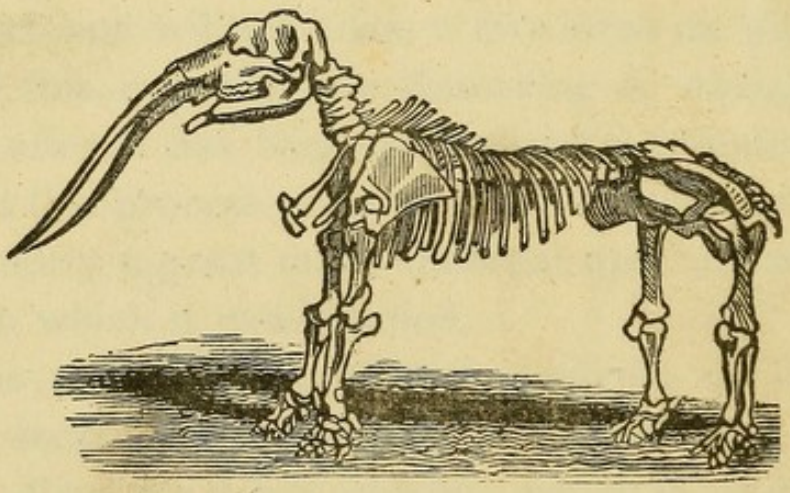
54. Is the gastric juice always the same? Are the organs of digestion always the same? 55. What good will result from a due regard to the rules laid down in this lesson?

CHAPTER II.

BONES.

1. Children, can you tell me to-day what it is that supports our bodies? You know houses have large timbers, called frames. What is the frame-work of the houses in which you and I live—that is, our bodies? "That is what I never thought of," said Mary. "Will you please to tell us?" said another.

2. It is our *Bones*, children. These are all joined together, and make what is called a skeleton. Here are two cuts, one representing the bones of the Masto-



THE MASTODON.

don, on a small scale. They were dug out of a large clay-pit in Orange co., N. Y., and are the remains of one of the largest animals in the world. It is so tall that a man, standing by its side, cannot reach the head with

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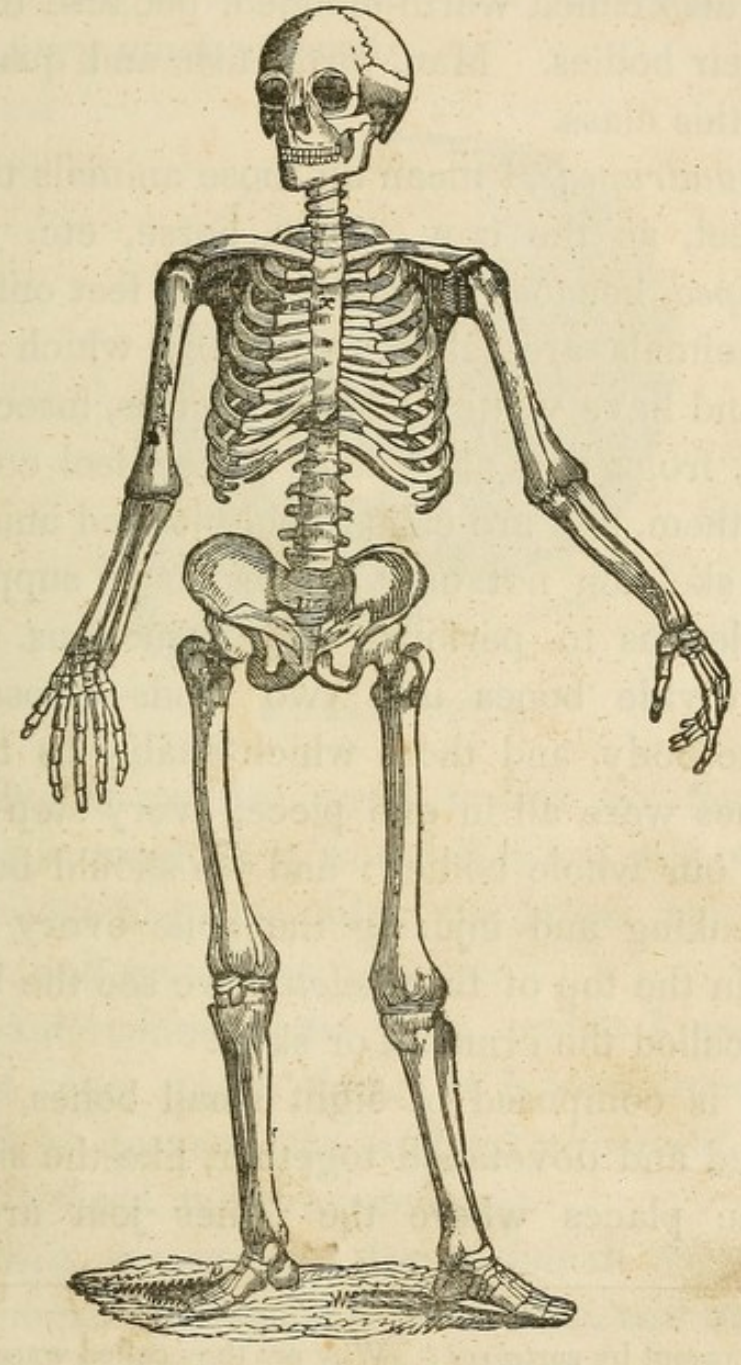
What is the subject of chapter second? 1. What have we in our bodies which correspond to the timbers in a house? 2. What is a skeleton? What do the cuts represent?

his cane. The other shows our bones, as they would appear without skin and flesh, and is called the human skeleton, which is the one we shall consider at the present time.



SKELETON OF A MAN.

3. I must first tell you that there are two great divis-

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2. To which will our attention be confined? 3. In what two great classes are all animals divided?

ions of animals called vertebral and invertebral, which you must all remember.

All animals are called *vertebral* which have a skeleton, and are sustained and nourished by red blood. They are also called warm-blooded, because they have heat in their bodies. Man, birds, fish, and quadrupeds, belong to this class.

4. By *quadrupeds*, I mean all those animals that walk on *four* feet, as the cow, sheep, horse, etc. Man is called a *biped*, because he walks on *two* feet only.

5. All animals are called *invertebral* which have no skeleton, and have white blood, as worms, insects, shell-fish, toads, frogs, and serpents. These feel cold when we touch them, and are called cold-blooded animals.

6. Our skeleton not only serves as a support, but also enables us to perform all our motions. In this view, we divide bones into two kinds—those which protect the body, and those which enable us to move. If the bones were all in one piece, every step we take would jar our whole bodies; and we should be in danger of breaking and injuring the bone every time we moved. In the top of the skeleton we see the bones of the head, called the cranium or skull.

7. This is composed of eight small bones, all very nicely fitted and dovetailed together, like the sides of a box. The places where the bones join are called

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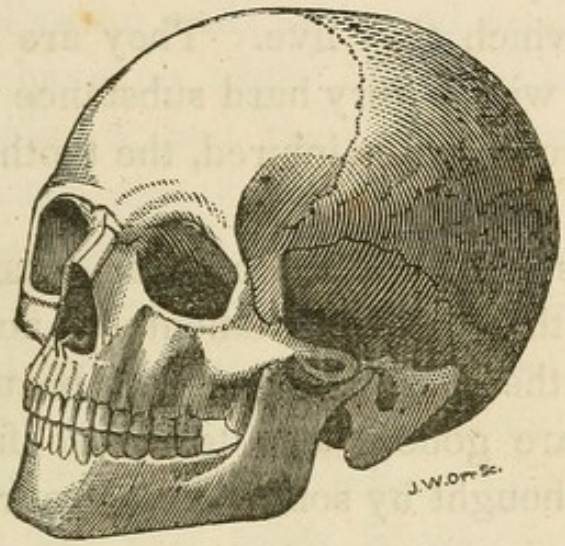
3. What is meant by *vertebral?* Why are they called warm-blooded? What are some of the animals that belong to this class? 4. What is meant by quadrupeds? What is a biped? 5. What is meant by *invertebral?* Why are they called cold-blooded? 6. What are the uses of our skeleton? What two different kinds of bones are there? What would be the consequence if the bones of the body were joined in one piece? What is the skull, and where is it situated? 7. How many bones compose the skull? How are these bones arranged? What are sutures?

sutures. In the little infant, the bones are soft and do not unite until it is several *months*, and sometimes several *years* old. You will see what a wise provision this is; for small children are continually tumbling, and if these bones were not soft and yielding, they would soon be very much injured.



HUMAN SKULL.

8. Being of an oval shape, it does not feel the force of blows so much as it would if it had any other shape. As the child becomes older, the bones are firmer and stronger, and give more support.

The skull contains the brain, which I may tell you about at some future time. It is very important that it should be guarded and well taken care of, as we find it is by its hard and firm covering.

9. There are several bones which form the face. The principal ones are the jaw bones, and those around the organs of seeing, smelling, tasting. As I told you

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7. What wise provisions do we find in the construction of these bones in children? 8. What good results from its shape? How does age affect the bones? What does the skull contain? How important is the brain? 9. What are the bones of the face? What is the use of the teeth?

in my previous lesson, we have teeth prepared for us to grind or masticate our food.

10. Some of you may think that the teeth are not worthy of our notice; but be very patient, and hear me. They are of as much service, and bear as important a relation to our bodies as any part of our framework; and they are as different in different animals, as the food on which they live. They are composed of bone covered with a very hard substance called *enamel.* When this decays, or is injured, the tooth is useless for strength.

11. This is sometimes destroyed when the dentist cleans the teeth, by his instruments or acids, which he uses. When the enamel is gone, the beauty and polish of the teeth are gone. The teeth are furnished with little nerves, thought by some to make our food pleasant to our taste.

Sometimes a tooth begins to decay, so that the nerve is exposed to the air, and then we experience acute pain. So tender is the nerve, that if it should be touched by an instrument or pin we could not endure the pain for half an hour. It is not the bone which aches when we say our tooth aches, but this little nerve which troubles us.

12. This nerve is covered by the enamel, and it is this which preserves the tooth sometimes for a hundred years, and even for thousands of years, as in the case of mummies bodies which have been embalmed, or

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10. How do some regard the teeth? How should they regard them? Do they differ in different animals? Of what are they composed? How important is this enamel? 11. In what manner is it sometimes injured? What are the results of its decay? With what are the teeth furnished, and for what purpose? What occasions the tooth-ache? 12. How is the nerve protected? How durable is the enamel? What are mummies?

preserved from decay by being washed all over with spices and various substances.

13. Let us examine some of the different kinds of teeth, and see how well they are adapted to the food necessary for different kinds of animals, and different periods in the life of man.

14. Infants live on milk, and need no other nourishment—so they have no teeth. As they become older, their bodies enlarge, and they need firmer bones to support them, and also require more solid food; but their soft gums cannot masticate or chew their bread, and apples, etc. So what do we see? The gums seem to enlarge, and what before was like jelly, makes its appearance, and the little infant has a tooth.

15. You, who have little brothers and sisters, know with what joy the first tooth is welcomed. "Why, baby has a tooth," cries the little prattler; but ah! she does not stop to think for what purpose it was given to her! Then one tooth after another grows, but these you know are only what is called the first set. If we could look inside of the gums we should see the little roots of another set.

16. The first teeth gradually fall out within five or six years, and then the other set enlarges and appears, to last us through life, if we will only take care of them. There have been several instances where the third set grew after the person was forty or fifty years of age.

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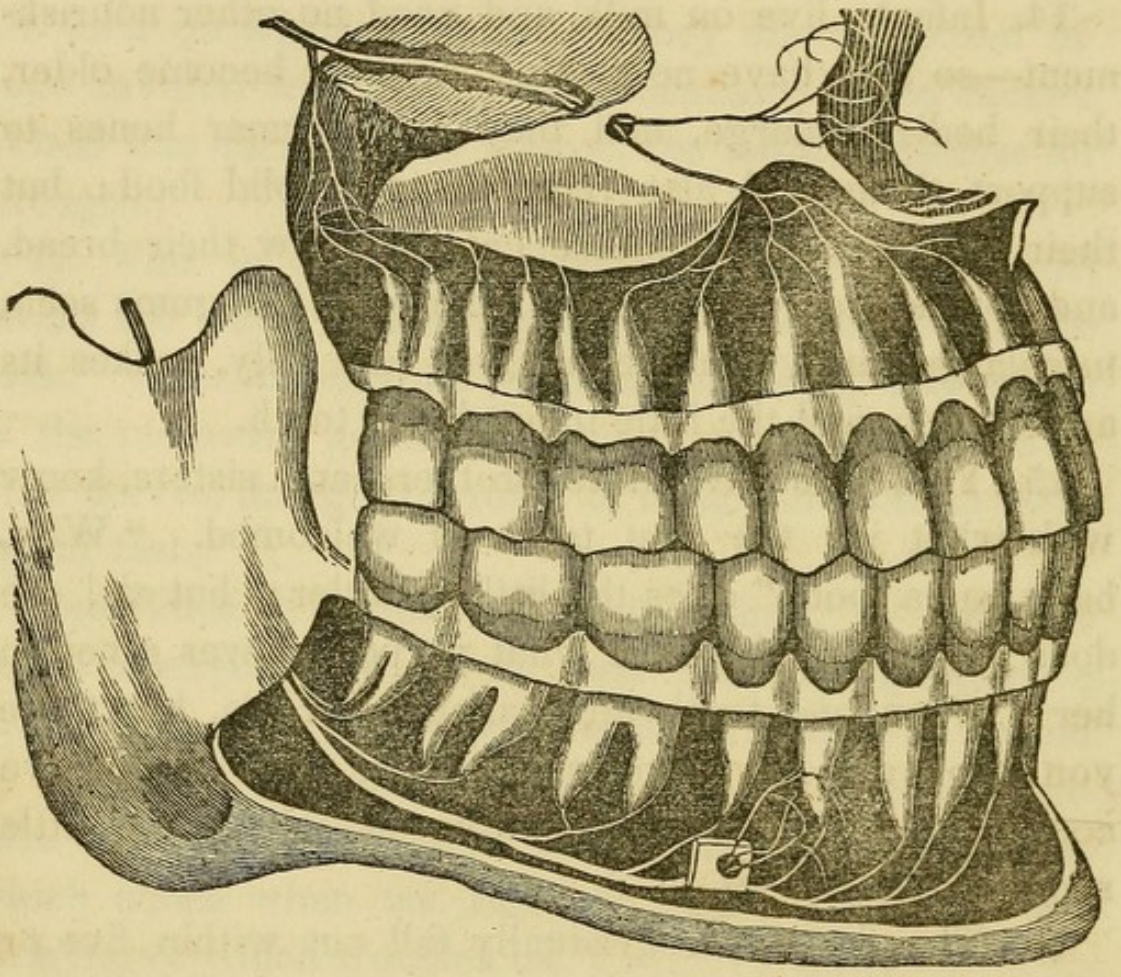
13. To what are the different kinds of teeth adapted? 14. Why have small infants no teeth? When does a tooth make its appearance? 15. How is the first tooth generally welcomed? How many sets are there? 16. How long does the first set generally last? What takes the place of the first set? How long will the second set last if we take care of them?

I know an old gentleman seventy years of age who has just cut his third set of teeth, but this is an extremely rare occurrence. Every adult person has thirty-two teeth—four cutting teeth in front, six canine, three at each side, and six molar or grinders, three each side



HUMAN TEETH.

on each jaw. I know an old lady who used to puzzle me very much when I was a child, by telling me that she had not a *single* tooth in her head, and never had one. The fact was, all her teeth were large and double—that is, with double roots or prongs; but I never

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16. What fact is mentioned respecting a man seventy years old? How many teeth has an adult person? What are they? Do all have both single and double teeth?

heard before of a similar instance, and think it must be very rare.

17. To preserve the beauty of our teeth, and to prevent their troubling us by aching, we must clean them thoroughly with cold water as often as once every day, particularly in the morning, and it would be better if this were done immediately after each meal. It was not intended by our Creator that we should lose our teeth at the age of twenty or thirty, and frequently before that time, or that art should take the place of nature by giving us artificial teeth.

18. Indians and negroes have, almost universally, beautifully white teeth; and they are made of the same materials; the same bone, the same lime forms them that is found in ours. Why then is there this difference? It must be either in the manner their food is prepared, as to heat or cold, or to the care they take of them.

19. Let us look at some of the teeth of different animals. I will first tell you that animals are called either carnivorous, herbivorous, or graminivorous. I will explain to you what these words mean, and then you can understand and always remember them. Those animals are called carnivorous which feed on flesh of other animals, as the lion, bear, tiger, etc. Those which live on grass, herbs, and vegetables, are called herbivorous, as the cow, sheep, etc. The grami-

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17. How can the beauty of teeth be preserved? Did our Creator intend to give us teeth that would not last us through life? How does art take the place of nature? 18. What kind of teeth have negroes and Indians? Do their teeth differ from ours in quality? In what must the difference consist? 19. Into what three classes are animals divided? What animals are called carnivorous? What animals are called herbivorous? What animals are called graminivorous?

nivorous are those which can feed either on herbs or flesh.

20. The carnivorous animals have sharp teeth, usually two on the upper jaw and two on the under, at the sides which project more than the rest, called tusks. The rodentia are those animals sometimes called gnawers, as the squirrel, chip-muck, beaver, etc. The beaver gnaws down large trees with its teeth to build its house. The mouse and rat, you all know, gnaw holes in boards whenever they can.

21. The bear and lion kill and tear in pieces their prey—the smaller animals on which they feed—and they therefore need stronger and sharper teeth than the cow and sheep, which live in peace with their neighbors, and never seek to take their life.

22. There is a small carnivorous animal, the mink, which has very little, but sharp teeth.

MINK TEETH.

23. To see them, children, you might imagine that he must be a dear little creature to have such fine pretty teeth; but he has a very fierce and cruel disposition. A gentleman once set a trap to catch some musk-rats,

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20. What kind of teeth have the carnivorous animals? What animals belong to the class called rodentia? What are some of the animals that belong to this class? 21. Why do the bear and lion require stronger teeth than the cow and sheep? 22. What is said of the mink's teeth? 23. What kind of an animal would some judge him to be from his teeth?

and it was his custom to give them to his dog to devour when they were caught.

24. One day a little mink found its way into the trap, and as usual was consigned to the dog. As the dog opened his mouth to seize the mink, the little animal stuck his sharp teeth through his tongue, and in spite of all the beatings and endeavors of the boys and men to get him away, they were unable to do so till they killed him; and then they were obliged to pry open his teeth. The poor dog could do nothing but stand still, so sudden and unexpected was the attack of the mink.

25. Some animals have no teeth, as hens and fowls, but they have a gizzard where their food is ground after they have swallowed it, which answers the place of a stomach and teeth.

Those creatures called the ant-eaters are destitute of teeth, but have a long slender tongue, which they thrust into the habitations of ants, and then draw it back covered with these little animals, which adhere to it on account of the thick saliva with which it is covered.

26. Wood-peckers have a long straight beak, fitted for piercing and splitting open the barks of trees; also a long slender tongue, covered toward the end with sharp bristles, which are turned backward, and covered with thick saliva; by which means they are enabled to get worms on which to feed. Serpents have sharp teeth bent backward.

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24. Relate an anecdote of a mink. 25. What animals have no teeth, and with what are they supplied? What is said of the ant-eaters? 26. What peculiarity is there in the wood-pecker? How are the teeth of serpents constructed?

27. Some are venomous and dangerous, and others do no injury, or scarcely ever bite at all. The venomous are armed with fangs, for infusing poison into wounds. These fangs are situated at the root of the teeth, in the upper jaw, and contain a little poisonous fluid, which is secreted by a gland under the eye, and which passes down to the fang by a little canal. When the tooth pierces the flesh, a portion of the fluid also enters the wound, and unless removed immediately, circulates by the blood throughout the system, and causes death.

28. When the fangs are broken or injured, they are renewed or grow again, and when not in use, are hidden from our sight by the gum. Those who tame snakes and play with them, generally remove the fangs, and keep them without water, which renders them comparatively harmless; yet they are dangerous playthings. If we had time, this would be a very interesting subject to pursue farther, but we must proceed to other bones of the body.

29. As we leave the teeth, the next principal bone which we see is the back-bone or spine. I have heard many ludicrous questions asked by larger children than any of you. Yes, even men and women have wished to know if they had some spine in their back-bone. This question showed their ignorance, for they should have known that the spine and the back-bone were the same thing.

30. The spine is not one straight bone, as many sup-

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27. With what are venomous serpents armed? Describe these fangs. 28. Are the fangs ever renewed? How are snakes tamed and rendered harmless? 29. What important bone will be next described? What mistake have persons frequently made in regard to the spine?

pose, running down the back, but it is composed of twenty-four pieces of bone. Each of these pieces is called a vertebra. These are joined by a soft *elastic*—which means, when anything is bent or stretched, and the force which was used is removed, returns to its first shape—substance, called cartilage, which enables us to bend our back. These vertebræ are hollow, and contain the spinal nerve or marrow, and serve as a pillar or column for the support of our bodies. They increase in size from the neck down. When a person breaks his back, as it is usually called, these cartilages are broken, which can never be joined again. When the spine is diseased, the person rarely enjoys health afterward.

31. As people become older they are shorter; and men who stand and write for any length of time also become shorter, because the ligaments of the spine press down upon each other. The skull is united to the upper vertebræ by means of a joint.

32. Here we see what a wise provision is made for our ease and motion; for if our spines had been attached to our heads, so that we could not move them, how stiff would have been our bodies; and had our limbs also been firmly joined, we should have fallen every step we moved; but we have what is called the hinge-joint, to enable us to move the head upward and downward, and what is called the ball-and-socket-joint, by means of which we can turn our head in every direction, and enjoy much more than if it was arranged otherwise.

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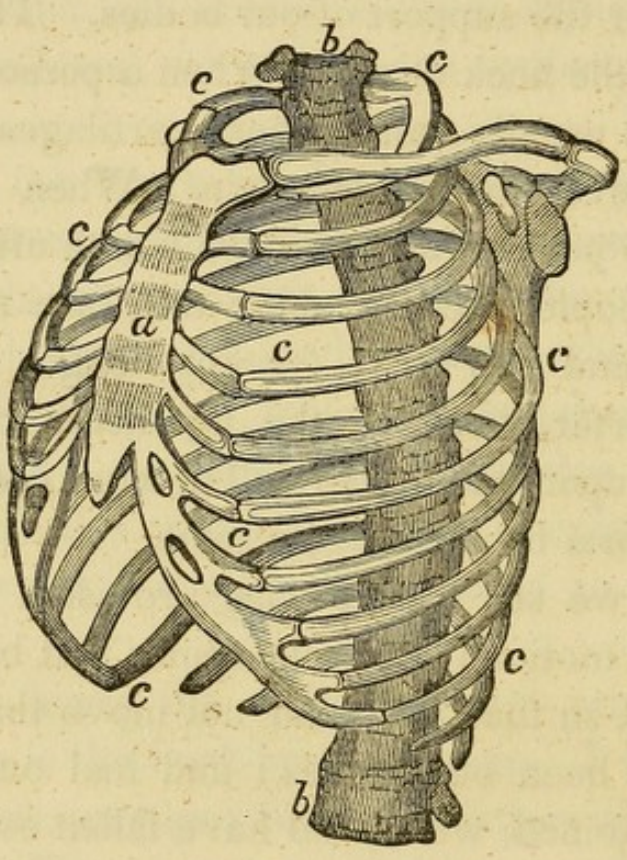
30. Of what is the spine composed? What is a vertebra? How are the vertebræ joined? What do the vertebræ contain? What do we mean when we say the back is broken? Do persons recover from a disease of the spine? 31. Why do people become shorter who stand for any length of time? How is the skull united to the upper vertebræ? 32. What advantage are the hinge-joint and the ball-and-socket joints?

33. In all the joints, the ends of the bones which work together are tipped with gristle, that they may move easily. The spinal marrow passes through the spine, and if this be once broken, the limbs below would become numb and motionless, and life would soon end. There is an innumerable number of nerves passing from this spinal cord to the stomach, to the heart, the liver, and to every part of the body.



RIBS AND BREAST-BONE

Joined to the spine *b*, *b*, are twelve ribs on each side, seven of which are united to the sternum or breast-bone *a* in front, that is composed of three small pieces of bone, which, although distinct at first, finally unite together, making one bone. These are called the true ribs: then

33. With what are the bones tipped, and why? What takes place if the spinal marrow is injured or broken? How is the spinal marrow connected with the stomach, heart, and lungs, etc.? How many ribs are there? Describe the sternum? What are the true ribs?

there are five which unite with the breast-bone by means of soft cartilages.

34. The collar-bone and shoulder-blade are also united to the breast-bone, and serve their purpose, the one forming the neck, the other the shoulder. The ribs are very important bones, for they enclose all those organs which give us life, and sustain it, as the lungs, heart, etc. So important are they, that we should be careful not to draw our clothing so tight around them that they will press upon these organs, for the ribs are softer than the teeth, and have also that substance called ligament—the same as in different parts of the spine—at the end, and they yield to any pressure upon them which sometimes causes death.

35. In a great many instances, where persons have been supposed to die with consumption, on examining their bodies after death, it was found that they had pressed their ribs so closely together that they had not power to breathe. In one instance which I have known, the lower ribs were closed over each other, so that the stomach could not digest the food, nor the heart circulate the blood, nor the lungs take in air. The action of all the internal organs was interrupted, which caused death.

36. We find a great many joints in the body, and in those situations where they are most needed. The arm is joined to the shoulder-blade in such a way that it can turn around ; at the elbow there is a hinge-joint, to move

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34. For what purpose are the collar-bone and the shoulder-blade? Why are the ribs important bones? What care should we take of them? 35. Is death ever caused by pressure on the ribs? Explain why this is the case. 36. Is there any system in the arrangement of the joints? What difference is there between the one at the shoulder and at the elbow?

it upward and downward. Some have supposed that the hinge on the door was first thought of by seeing it at the elbow. Then we find another at the wrist, also in all the fingers. There are twenty-seven bones in the hand and wrist. We might have had hands to move, made of only one solid piece of bone.

37. In this way we could not have used them for one half or three-quarters of the purposes we now can. We could not write to our friends; we could not raise our food to our mouths; the mechanic could not use his tools, however perfect they were; the lady could not play on her piano; the mother could not knit her stockings; the little girl could not sew and make her doll-baby's dresses; the little boy could not make his kite, nor spin his top, nor play with his marbles.

38. Every one would immediately say how inconvenient this would be. There is one man without arms who can do almost anything he undertakes; yet there is not another one to be found in the United States, or in the whole world. We could not move our limbs, our feet, or our toes, without joints. Think how awkward all our movements would be if our limbs were immovable, or were composed of solid bone. We should be confined to one spot, and could not walk or move.

39. What a world this would be, if its people were jointless, and what a blessed thing it is that we are furnished with these instruments! *Man* is the only

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36. Is there anything in a house that resembles the hinge-joint at the elbow? How many bones are there in the hand and wrist? 37. What advantages arise from the great number of these bones? 38. Is there any instance where the other limbs have been substituted for the hands? What would be the consequence if we were jointless? 39. What distinction is there between man and other animals? What places man above monkeys?

animal that has *hands*, though the *forefeet* of monkeys *resemble* our hands, as they have nails like those on our fingers, and they can also use their feet very handily; but they have no intellect.

The *foot* is also remarkably constructed with its twenty-six little bones, connected with little joints, so that we can move very easily. If we look on the sole or bottom of the foot, we shall see that the middle of it appears as if arched or cut out. This enables us to walk more easily and gracefully, to run, skip, and jump, and to perform every motion we wish.

40. On examining the feet of different animals, we find that they are fitted or adapted to their peculiar wants and necessities, and to their character, food, and manner of life. The feet of apes and monkeys are constructed so as to enable them to climb trees; and in their native state, they live among the trees, and are continually climbing and hanging on the branches.

41. The mole lives in the earth, builds her house under the ground, and rears her young there; and they can dig through grass, and even hard gravelly earth, with their feet. The fore-feet of the goat, sheep, ox, and camel, have hoofs, which are double; but they have the appearance of a single one cut in two, and are called cloven. The camel has large, and what *we* should term, homely feet, but these are to support and move a large and unwieldy body, and to travel over the deserts of sand.

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39. How many bones has the foot? How are they connected? Is there any peculiar arrangement to the sole of the foot? What advantage is it? 40. To what are the feet of different animals adapted? How are the feet of monkeys and apes constructed? 41. How does the mole use her feet? What can you say of the fore-feet of goats and sheep Describe the feet of the camel. How are they adapted to his wants?

42. The lion and tiger feed on other wild beasts, and tear their prey in pieces. So they have strong fore-paws—strong enough to tear a man's shoulder from his body, and sharp claws on their feet to assist them. Birds of prey, or those birds that feed on other birds, as the kite, the eagle, etc., have crooked and powerful talons or claws, to enable them to seize other birds.

43. The whale is furnished with fins, called oars, instead of fore-feet, which are supported by bones similar to the fore-feet of quadrupeds. They have no hind-feet, but have a thick tail, which has a fin or oar. By means of these fins they sail with great rapidity through the water, and can strike a boat or ship with such force with their tail as to cut it into pieces.

44. The parrot, wood-pecker, and others of that class, have the outward toe on each side turned backward, which enables them to grasp substances more firmly with their claws, and affords them a sure support in climbing. They can cling with great force to the rough bark and branches of the trees.

45. Then there is another class of birds—the goose, duck, pelican, etc., which are called web-footed, because their toes are connected by a web or membrane which fits them for swimming.

46. Their legs are situated far back on their bodies; their feathers are thick, smooth, and oily; their skin under their bodies is covered by a layer of close down,

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42. How are the feet of the lion and tiger adapted to their necessities? With what kind of feet are the birds of prey furnished? 43. What serves the whale instead of feet? What enables them to sail in the water? How strong is their tail? 44. What enables the parrot and wood-pecker to climb and support themselves? 45. What are web-footed birds? For what does this construction fit them? 46. How are their legs situated? By what is the skin underneath their bodies covered?

which prevents them from coming in contact with the water; they have long necks, so that they are enabled to procure their food from the bottom of the water without difficulty. When you see the swan gliding so prettily over the water, think how well adapted she is for her situation!

47. There is one bird, the pelican, that has a bag or pouch in its bill to hold the fishes and worms till it has need for them.

48. The principal bones of some animals are on the outside of the body, and serve as a covering or protection to the other parts, as in the lobster. Lobsters belong to the class of invertebral animals, and have no skeleton or internal bones; but they are covered by a thick shell, which serves them for two purposes—it is a shelter for all the softer parts of the body, and is the instrument of motion.

49. *We* have bones fitted and joined to enable us to move; but the *lobster* has not. Instead of them he has a thick shell on his back. This keeps him warm, and prevents his exposure to the rain and the cold; it is a nice and snug house in which he may repose in peace and quietude. You would probably ask if this shell grows in the same manner that our bones increase in size.

50. This shell is incapable of growth. As the animal increases in size, he throws off his old shell to change it for another. When this is cast aside, his soft body is

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46. What advantage is their long neck? 47. Where does the pelican put its food? 48. Are the bones always underneath the skin? Describe the bones of the lobster. 49. How do the bones of the lobster differ from ours? Describe the house in which the lobster lives. 50. Does this house ever increase in size? What does the animal do when his shell is too small?

exposed, and remains in a defenceless state; but by *instinct*—which I shall explain hereafter—he hides himself away in some retired spot, where he can wait in security till a new shell is formed. This is done by a hard substance resembling lime, which is left on the outward surface of the skin by the blood in its circulation, that grows firm and hard, and finally fits over the body and makes a new shell or covering.

51. Insects have no internal skeleton, but are provided with a hard external covering, which serves to support their motions, and protect their organs. In some it forms a complete shell. In others it consists of a tough muscular coat divided into rings. Clams and oysters have no bones. They are supplied with muscles, which permit them to move, and living in a warm house, they can spend their life answering the end for which they were created.

52. Fishes are covered with a thick, strong skin, and generally have scales arranged over each other, like the shingles of a house. Their bodies are covered with a thin slimy matter, which defends them from the water, and they breathe by means of their gills, through which they take in air.

53. Crocodiles are covered with a thick coat of scales, which are proof against a bullet, or blows of any kind. This covering appears very fine, resembling carved work. The crocodile is from twenty to thirty feet in length, and can run with the speed of a man,

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50. How is the new shell formed? 51. Describe the bones of insects? What is their use in different animals? What have clams and oysters instead of bones? How are they enabled to move? 52. Describe the covering of fishes? How do they breathe? 53. Describe the covering of crocodiles. How great is their speed?

and being insensible to blows, is very dangerous. When a person is pursued by one, he can scarcely avoid him in any other way than by making a turn; for they are so long that it is difficult for them to turn their bodies around.

54. The turtle and tortoise have an upper and lower shell, joined at the sides, through which the head, tail, and four extremities extend. The upper shell is formed by the extension and enlargement of the ribs and part of the back-bone, and the lower one by the sternum or breast-bone, so that a part of their skeleton is on the outside of their bodies; the ribs, breast-bone, and vertebræ, forming their shell or covering. Their stomach is simple, their intestines long, and they are capable of going without food for a long time.

55. They are very tenacious of life, have strong muscles, especially in the mouth and throat; for, when they bite anything, they will not open their teeth, even if whipped or beaten with a stick. A turtle once caught a fine little gosling in the water by the wing, and held him fast by the teeth, and would not let him go till some one shot him with a rifle, which stunned him. A person once caught a turtle, cut off his head, and threw it away; but for several days afterward, the body moved around the house as though alive, owing probably to muscular contraction. I might tell a great many interesting *facts* about different birds and animals, but I must pass on to different subjects.

The bones are covered by a thin substance called

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53. How can crocodiles be avoided? 54. Describe the covering of the turtle and tortoise. How is the upper shell formed? How is the lower shell formed? Do they require much food? 55. How strong are their muscles in the mouth and throat? What anecdote is related of a turtle?

periosteum. When this is diseased people have the rheumatism.

56. Perhaps some will say, why do not the joints rub together and prevent their moving? This would be the case if they were not continually moistened by a fluid called synovia, which enables them to move very easily, in the same way that wheels can turn much faster and better when well oiled. If there were nothing to moisten our bones, they would creak, and make as much noise as some carriage-wheels do when not properly oiled.

But the bones and joints alone would not enable us to move in all the various directions we desire; therefore nature has provided us with a great many different muscles for this purpose, as well as to give form and proportion to the body.

57. The following cut represents a man with the muscles which cover the bones, without the skin. The muscle is what we call lean meat. Do not forget, children, when you eat beef-steak, that you are eating the muscles of the ox, which keep his bones together, and enable him to draw the great loads. The muscles are red because they contain blood.

58. They cover the bones, crossing the joints, running along up the limbs, over the back, arms, and neck, and are particularly large and numerous where they are most needed, as in the back, hips, legs, etc., and though

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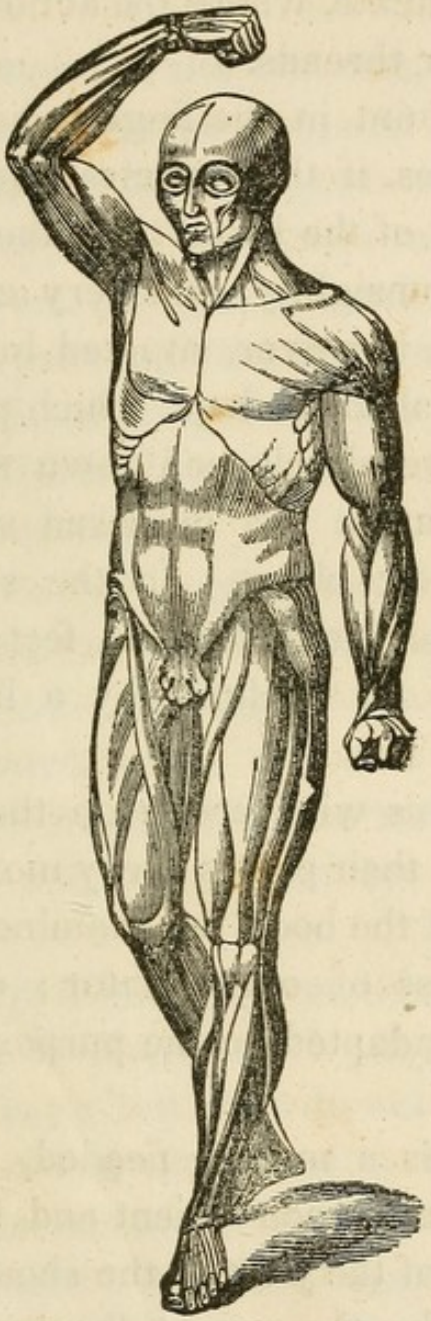
56. By what are the bones covered? What is the rheumatism? Do the joints rub together? What enables them to move easily? What would be the result if the bones were not moistened? What is necessary beside bones and joints for all our motions? What is the office of the muscles? 57. What is represented by the cut? What is muscle? What are the muscles of the ox? Why are the muscles red? 58. How numerous are the muscles?

so numerous they never interfere with each other. Sometimes the action of a muscle is needed where, if it



MUSCULAR MAN.

were placed, it would be quite inconvenient. Now mark the remedy. *We* could not have devised a better or more ingenious one if we had bestowed a great deal

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58. Is the action of muscles ever required where their position would be inconvenient? How is this remedied?

of thought on the subject. The body of the muscle—which means the centre of the muscle, and is generally the largest part—is placed at a proper distance, and made to communicate, where the action is necessary, by slender strings or threads.

59. As every joint in the fingers, hands, and feet are moved by muscles, if the muscles had been placed in the palm or back of the hand, or in the feet, they would have been very unsightly, and very clumsy in appearance. They are, however, situated in the arm, and act by long strings called tendons, which pass to the joints. These tendons are all clasped down at the wrist by a bracelet which nature has prepared under the skin to keep them in their place. In the same manner the muscles which move the toes and feet are placed along the leg, and are all confined by a little band at the ankle.

60. Without this wise provision the tendons would have sprung from their places every movement we made. Whatever part of the body we examine, we see the wisdom and goodness of our Creator; every part is so nicely fitted and adapted to the purpose for which it is used.

Where there is a muscle needed, there we find it arranged in the most convenient and beautiful manner. Suppose instead of the joint at the shoulder we had had the hinge-joint, like the one at the arm, then we could

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58. What is the body of the muscle? 59. Where are the muscles which move the hands and feet situated? Why are they not placed in the hands or feet? How are the tendons confined at the wrist? How are they confined at the ankle? 60. What would take place if they were not bandaged? What do we see displayed in every part of the body? What adaptation is there in the body?

only have moved our arm and shoulder upward and downward, which would have been much more inconvenient than it is now, when we can turn it in every direction.

61. When we wish to raise our arm, our minds speak to the muscles leading to the arm, and tell them to contract or shorten, and they, like good and obedient children, instantly obey, and the arm is raised. When we desire to put it down, our minds speak to another set of muscles, which expand, and the arm drops.

When John refused to get up this morning, it was because his *mind* did not direct the proper muscles, and not because *they* refused.

62. And when Sarah's mother told her that she must knit so many rounds, or do so much sewing, before she went to play, her little muscles did not move one half so quickly as afterward, when she was engaged in her sports—and why? simply, because her mind was not so much interested, and, of course, her muscles moved more slowly.

63. How often is it that children think they have very hard tasks given to them, which they cannot possibly perform, as *they* say; but they do not consider that if they are disposed and interested in their labor, their muscles will assist them as readily as at play, when they frequently take very hard exercise. When the intemperate man falls to the ground, or totters along, it

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60. Why would it not have been as well to have had the hinge-joint at the shoulder? 61. Explain how we raise our arm? Explain also how we put it down? Do the muscles refuse to obey the mind? 62. When do the muscles move most rapidly? How is this illustrated in case of the little girl? 63. Why do the small tasks of children sometimes appear difficult? Why do intemperate men often fall to the ground?

is because he has not command over his mind—hence none over his muscles.

64. In no part of the system is the variety, quickness, and accuracy of muscular motion so remarkable, as when we move our tongues in speaking. Every word we speak, every syllable we utter, requires a distinct action of a muscle. If you will notice the many different positions of the mouth in talking, you will be surprised to find that there are numerous persons, who are deaf and dumb, but who can understand what others say by watching the muscles of the mouth.

65. We also move a great variety of muscles in our hands when we write, or otherwise use them; also in our feet, when we walk; and when we eat, and in everything else that we do. Different animals also have muscles to assist their motion. Those without bones depend on muscles alone.

66. The elephant has a very short neck, and a large and clumsy head; consequently it would be impossible for him to take up his food and drink from the ground, like other animals, so he has a trunk or proboscis. This is a long flexible or movable organ, composed of a great number of muscles which contract and expand, and enable him to move it in every possible direction as he pleases. His trunk is endowed with the sense of smelling and feeling to a great degree of perfection. At the extremity there is a hollow, like a cup, which he is

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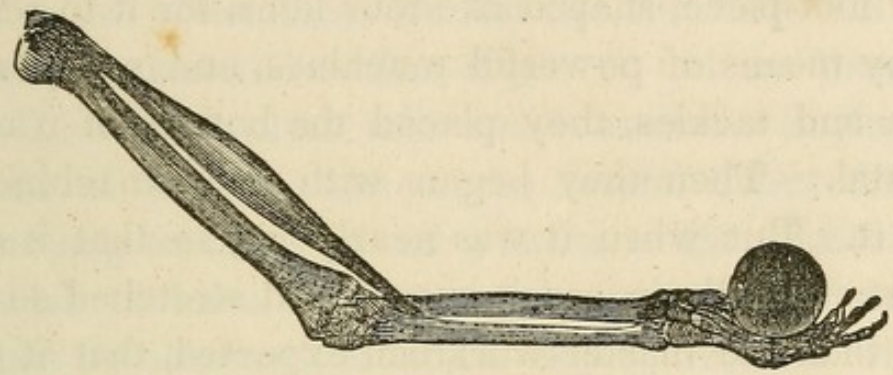
64. What is said of the muscles of the tongue? Could we speak without muscles? How can the deaf and dumb understand many things that are spoken? 65. In what parts of our bodies do we use a great variety of muscles? On what do animals who have no bones depend? 66. How does the elephant take up his food? Describe the trunk. With what is the trunk endowed? What is there at the extremity?

able to bend and turn so easily that he can take up his food and put it into his mouth, and can also take up water and force it through the nostrils into the mouth. I shall tell you more about this curious animal when I speak of the instinct of animals.

67. You will understand better what is meant by the contraction and expansion of muscles if you will take a piece of india rubber and stretch it. This will show



THE ARM.

the expansion; and when you remove your hand it will take its original size and appearance; this will show the contraction: but in our bodies there are *two* sets of muscles, one for contraction, and the other for expansion, as you will see in the cut of the arm, and also the manner in which they are joined to the arm.

68. Dr. Alcott relates a very interesting fact to illustrate the action of the muscles, as follows: "In front of St. Peter's church, at Rome, stands an obelisk, or pyramid, of red Egyptian granite, one hundred and twenty-four feet high. It was brought from Egypt to Rome, by order of the Roman emperor Caligula, where

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66. What are the uses of the trunk? 67. How can you show what is meant by the expansion of muscles? Also the contraction of muscles? What does the cut represent? 68. In what way does Dr. Alcott illustrate the action of the muscles?

it lay partly buried in the earth, on the spot where it was laid down, till about two hundred and fifty years ago, when Pope Sixtus V., by the help of forty-one strong pieces of machinery, eight hundred men, and one hundred and sixty horses, in eight days succeeded in getting it out of the ground; but it took four months more to remove it fifty or sixty rods farther, to its present situation.

69. "When they had at length reached the spot, the grand difficulty was to raise it. They erected a pedestal or foot-piece, shaped like four lions, for it to rest on; and by means of powerful machines, and many strong ropes and tackles, they placed the bottom of it on the pedestal. Then they began with their machinery to raise it. But when it was nearly up, so that it would almost stand, the ropes, it is said, had stretched so much more than the master-workman expected, that it would go no farther.

70. "What was to be done? Fontana, the master-workman, had forbidden all talking, and they now stood holding on the tackles so silently that you might have heard a whisper. Suddenly an English sailor cried out, 'Wet the ropes.' This was no sooner said than done, when, to the surprise and joy of everybody, the ropes shrunk just enough to raise the obelisk to its place, where it has now stood two-hundred and fifty years, and where it may perhaps continue to stand many thousand years, unless an earthquake should shake it down." Our muscles contract and shorten to move our bones, in the same way that the ropes shrunk to move

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69. What difficulty was there when the pyramid was removed to its present situation? How did they attempt to raise it? What new obstacle occurred? 70. What had been the orders of Fontana? What plan was suggested by the Englishman to succeed. Did it succeed? How do our muscles resemble the ropes?

the pedestal, and also add much to the beauty and proportion of our bodies.

71. As I told you in the previous chapter, all these two hundred and fifty-two bones, and five hundred and twenty-seven muscles, are formed from the blood, and that is made from the food we eat; therefore you must not only be careful, children, about the quality and quantity of your food, that you may have good bones and muscles, but you must take care of these bones and muscles when they are made; for they will soon become diseased and useless if you do not use them.

72. Hence you must take much exercise in the free, pure air of heaven: do not be fearful about running and jumping so as to use all your muscles. Little girls who wish to have strong muscles when they are old must not be ashamed, as some ladies are, to work and assist their mothers, and to run about in the open air.

73. Nearly everything is strengthened and improved by use, and weakened by disuse. You may say that your clothes wear out the more you use them; but such is not the case with the bones and muscles, for although they are continually changing, yet the blood is as constantly forming new ones by depositing those little substances, as when you cut your finger, of which I have hitherto spoken.

74. There is a substance which surrounds the muscles, of a yellow color, called fat. It is this which nourishes us for a long time when we are sick, and do not take

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71. How many bones are in the whole system? How many muscles? From what are the bones and muscles formed? Why should we take care of the muscles? 72. How can you keep your muscles well and strong? How can little girls secure good muscles? 73. Does use wear out the muscles? Why not? 74. What is the fat? What is the use of the fat in sickness?

much food. Some persons always express wonder when they see any one very thin and emaciated after a severe fit of sickness ; they would not be thus surprised if they took into consideration the fact that the fat has all been consumed, and that they must eat heartily again, to make more fat to cover their bones and muscles.

75. There are some animals, like the bat and bear, which, as soon as cold weather approaches, retreat into their houses or dens, and remain there all winter in a sleepy, torpid state. They take no food during this time; but their bodies are nourished by the fat, so that when they awake in the spring they are very thin and poor. Sometimes the fat makes its appearance on the outer surface of the skin, and forms pimples. Too much fat is unhealthy, and prevents a free circulation of the blood.

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74. Should we be surprised to see the fat gone after a fit of sickness? 75. In what state do the bears and bats live during the winter? What is their appearance in the spring? What are pimples? Does the fat make us healthy?

CHAPTER III.

SKIN.

1. If we had bones and the red muscles only for a body, we should present rather a rough and ugly appearance; but we have a covering drawn over the muscles, called the skin, which conceals them from view. Perhaps you have never thought much about the skin, but have merely supposed, as many undoubtedly have, that it is only a simple substance. This is all that some either think or care about it; but they are quite mistaken in regard to the importance of our knowledge respecting it.

2. The skin is sometimes soft, smooth, and delicate; then it is thick and wrinkled, as in the palms of the hand, or the soles of the feet. It consists of three coats or membranes, which I will describe.

The first is called the *cuticle* or *epidermis*. This is a very thin covering, and is seen when a blister is raised. It is this layer that peels off in cases of fever. This covering is soft or hard, and becomes so by the manner we use it. If the cuticle were as soft on the feet as we find it to be on the hands, little boys could never run barefooted as they do; but it becomes almost as tough

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What is the subject of chapter third? 1. Where is the skin situated? How should we appear if our bodies were composed of bones and muscles only? What opinion do some persons entertain respecting the skin? 2. Is the skin always of the same thickness? Of how many coats does it consist? What is the first? Describe the cuticle. How does the cuticle become hard?

as leather. A great deal, however, depends on the manner we use this, as well as every other part of the body; for the stage-driver's hands, that are exposed to every variety of storm, are composed of the same material as that of the delicate lady who always uses a muff.

The cuticle on the foot of an infant is as soft and tender as on any part of the body, and does not become hard till the child has walked.

3. This thin cuticle is transparent—which means that we can look through it as we can through glass and water—and has little pores, but no veins or blood-vessels. This skin continued, makes our finger-nails, which protect the ends of the fingers, as the cuticle does the skin.

4. Immediately underneath the cuticle is another layer, called the *rete mucosum*. There is more feeling in this layer than in the first. Spread over this skin is what is called the *coloring matter*. It is a great mistake to suppose that because some have a black, and others white, and others red complexions, that the *whole* blood and skin are of different colors. The only difference between the blackest person who ever lived and the whitest, is in this liquid on the surface of the second skin, which is either black, or white, or red.

5. The third layer is called, to give you another hard name, the *vera cutis*, or the true skin. Over this are

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2. What constitutes the difference between the hand of the lady and that of the stage-driver? Is the cuticle naturally harder on the feet and hands than elsewhere? How does it become so? 3. What farther can you say about the cuticle? What are the finger-nails, and what is their use? 4. What is the second layer of the skin? What is meant by coloring matter? What constitutes the difference in color among individuals? 5. What is the third layer of the skin?

little nerves, which run backward and forward in all directions, proceeding to the brain, and produce all the pain or sensation which we feel when hurt or injured.

6. When the surgeon takes off a limb, it is not in cutting the bone—if the bone be in a healthy state—that we experience pain, but only when the third skin is cut; and it is for this reason, that it is called the true skin. When we prick ourselves with a pin or needle, we draw blood, how slight soever the wound, because the two outer skins are so thin and delicate that the third feels the touch instantaneously, and the nerves of feeling being so numerous, pass off to the spinal marrow in the spine, and thence to the brain or mind, so that we feel every touch.

7. You have probably noticed that some persons have scars on their bodies from cuts or burns, and that these remain as long as they live. This is so, because, when the third layer, or true skin, is injured in any way, it never grows again; so when we cut or burn it, the wound may heal, but the scar will always remain. You frequently hear people say that children will "out-grow" scars. They sometimes do, it is very true, disappear; but it is when the two outer skins only are affected, that the scar will be removed; for these two skins can be formed again from the blood.

8. There are many who receive accidents when they are quite young, and though the hand, or limb, or part of the body affected, increases very much in size, yet

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5. What produces pain or sensation? 6. What causes pain when a limb is cut off? Why do we *feel* the prick of a needle? 7. Why do scars frequently remain on the body? When do scars sometimes disappear? 8. Do not children ever "out-grow" scars?

there will always be a scar left. There will frequently be white spots on the bodies of negroes, occasioned by wounds in the third skin, and the removal of some of the coloring matter on the second, which does not grow again.

9. Here again we see how wonderfully good our Creator was, in furnishing a covering for this part, which is so sensitive to every impression, and which, if exposed, would continually be in danger of injury at every step we take, but which is now shielded, as it were, from heat and cold, and all harm.

10. There are little cells or pores on the outer surface, which permit the sweat or perspiration to pass through; and in this way many diseases which lurk about our bodies are continually passing off. This enables us to endure the very great heat of summer; for this constant perspiration produces a moisture which cools the air.

11. There is then one very important thing for us to do, to keep this skin in order, and what do you think it is, children? The little pores are very small, so that when there is a blister formed, and filled with water, which puffs up the cuticle, the water cannot escape through them.

That very important thing for all to remember, is, *to bathe the whole body, at least once every day*, that the pores may not be closed by the perspiration which passes off.

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8. Why do we occasionally see white spots on the bodies of negroes? 9. How is the goodness of our Creator exhibited in the construction of the skin? 10. What is the use of the little cells on the surface of the skin? 11. What important thing have we to do? What would be the result if the pores of the skin were to close?

12. It is not sufficient to follow the example of too many boys and girls, and I am afraid children of an older growth—merely to put a little water on their hands and faces; many children would like to run off to school without doing even that: but that part of our bodies covered by clothing must be kept clean, as well as our faces and hands, if we wish to preserve our health, our life, and happiness.

13. All children can do this themselves, without troubling their parents; and if they will do it, I can assure them that they will each have a longer life and more enjoyment; for if the particles are suffered to remain on the skin we cannot breathe so well, and of course would soon become diseased.

14. If the windows of a house should never be washed, they would soon become nearly useless, and would give us very little light or pleasure. If the paint and shingles were never repaired, the house would soon fall to decay, and be unfit for us to live in; so it would be as bad, and even worse for our house—that is, our body—if we did not repair or clean what has been called the shingles of our house, that is, the skin. The nails and hair are appendages to the skin; the nails are formed by little layers of thin skin, and serve to protect the ends of the fingers.

15. The hair is for a covering to the skull, each hair having a little bulb or root which has a nerve of sensation. Some say that the coloring matter is contained in

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12. Will it not be sufficient to wash our hands and faces only? What depends on the cleanliness of the skin? 13. Who can relieve parents of this trouble? What will be the good results? 14. How can we apply the principle to the windows and paint of a house? What are the nails and hair called? 15. What purpose does the hair serve?

this little bulb; others, that it passes through the little tube in each hair. Sometimes the root decays, and then again the skin becomes diseased. In either case the hair falls off, and is dead, or has no life.

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15. Has the hair any nerves? Where is its coloring matter? When does the hair fall off?

CHAPTER IV.

THE HEART AND LUNGS.

1. I WILL now tell you, children, about this curious heart of ours. You will recollect that you learned in my first lesson, that our food made blood. Suppose, then, we had bones, muscles, ligaments, skin, and stomach, but no vessel or receptacle to receive the blood when it was made.

2. Life, under such circumstances, could no more be sustained, than a steamboat could sail through the water of a thousand little streams, if it were not collected together in a river or bed of water. The heart is a double organ, and lies in the middle of the chest, with the point inclining to the left side, which gave rise to the idea that it was situated there.

The letter *a* is the left ventricle; *b*, is the right ventricle; *c*, *e*, *f*, is the great artery that proceeds from the left ventricle; *g*, *h*, *i*, are arteries that proceed from the great artery; *k*, is the artery that goes from the right ventricle to the lungs; *l*, *l*, are branches of the artery going to the two sides of the lungs, which carry the blood there; *m*, *m*, the veins which bring the blood back from the lungs to the left side of the heart; *n*, is the right auricle; *o* and *p*, are the ascending and descend-

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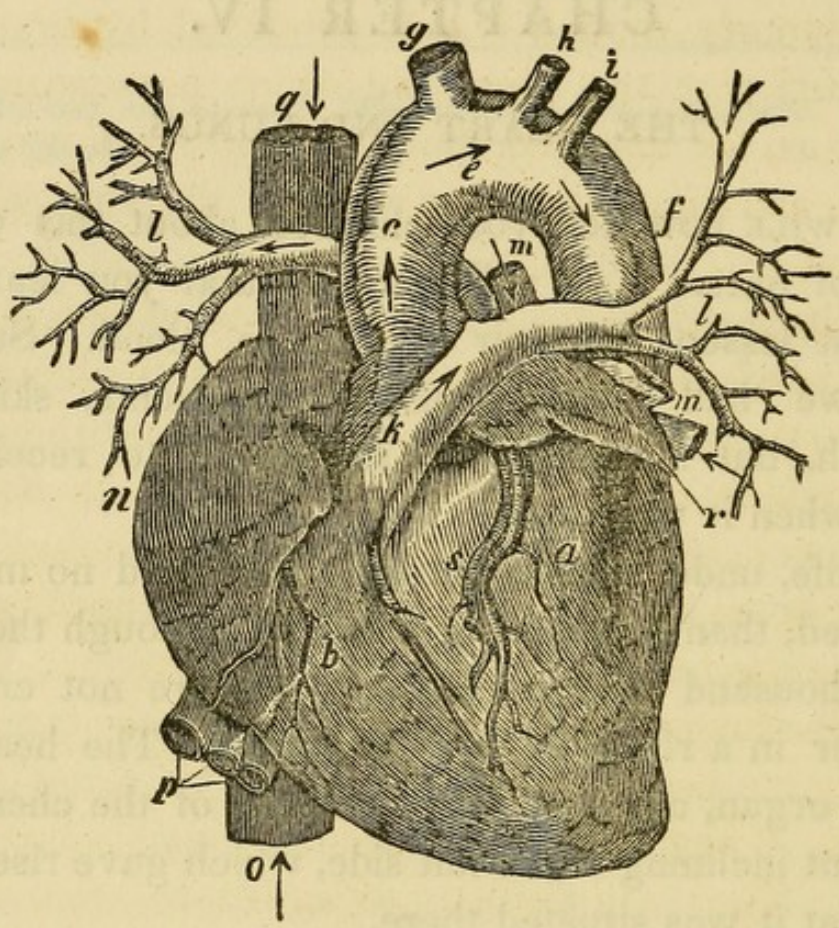
What is the subject of chapter fourth? 1. What do we need beside skin, bones, muscles, and blood? 2. What would be the result if there was no receptacle for the blood? Describe the heart and its situation. Explain the cut.

ing veins, which meet and form the right auricle; *p* represents the veins from the liver, spleen, and bowels; *s*, is the left artery, one which nourishes the heart.



THE HEART.

3. The heart has four divisions: two to receive the blood after it is made from the food, called *auricles;* and two others, called *ventricles*, to send it to the several stations where it is most needed.

4. After the blood comes to the heart from the veins, it is necessary to send it to the lungs before it is fit for use. For this purpose there are muscles in the heart which contract and force it out to the lungs.

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3. How many divisions has the heart? What are they called? What is the office of the auricles? What is the office of the ventricles?
4. Where is the blood, that comes to the heart from the veins, sent? How is this accomplished?

5. Motion is of two kinds: voluntary and involuntary. That is voluntary, which is performed by means of the bones, muscles, and tendons, and is influenced by the will or mind.

Involuntary motion is that produced by organs not connected with the bones, but which possess muscular fibres; as, for instance, the stomach, which is a hollow muscle, and digests its food without the knowledge of the mind.

6. The heart is also a hollow muscle, which contracts and expands, to receive and send out the blood when necessary. It is protected by a bag called the pericardium, which is made of strong and rough materials. This case holds a very little water; just enough to permit the heart to move freely and easily, and is placed between the lungs.

7. The lungs fill all that cavity in the chest, not occupied by the heart, and are composed of blood and air-vessels. They are so light that they would float in the water. They are sometimes called bellows, because they contain so much air. They appear like the branches of a tree, and extend each side of the heart. When we take in a breath of air, we *inhale* it; when we throw out a breath we *exhale* it.

8. We *inhale* it, to change the color of, and to purify

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5. What are the two kinds of motion? What is voluntary motion? What is involuntary motion? What is an example of involuntary motion? 6. How is the heart enabled to receive and send out the blood? By what is the heart protected? What does this case contain, and for what purpose? Where is the heart situated? Of what are the lungs composed? Where are the lungs situated? What is said of their weight? What are they sometimes called? What do they resemble in appearance? What is meant by inhalation? What is meant by exhalation? 8. What is the use of inhalation? What is the use of exhalation?

the blood. We *exhale* all that does us no good, but which would, if retained in the body, be an injury to us. You know, children, that air is all around us; we could not move or live without it; and though we can neither see nor handle it, yet it has been divided into several gases, called oxygen, carbon, and nitrogen.

9. When the air is thus divided, one part of it will sustain life, and the others are very injurious. The oxygen of the air unites with the dark blood in the lungs, and turns it to a red color, which then rushes back into the heart. The muscles of the heart contract, and send it out through the vessels, called arteries, to make skin, bone, flesh, hair, nails, and every other part of the body. It finally terminates in the small capillaries and veins, when it is changed into a dark red color.

10. It is then unfit again for nourishment, as some of the good qualities have been taken out in its circulation. This dark red blood then unites with the chyle, is sent into the heart, thence to the lungs, and is purified by the air, then sent back with its color changed, and proceeds as I have previously stated.

11. You may ask why the blood does not rush back again to the heart after it has entered the artery. It is because there are little valves or trap-doors that shut over the arteries when the blood has entered them.

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8. Is air confined to any particular space? Into which has it been divided? What are these gases called? 9. Are these different gases equally healthy? What effect has the oxygen on the dark blood, and what becomes of the blood? By what means is the blood sent from the heart? For what purpose is it sent through the arteries? What becomes of this blood? 10. Why is this blood then unfit for nourishment? Describe the farther course of the blood. 11. What query might here suggest itself? What prevents the flow of the blood back again into the heart through the artery?

These move as easily as a door closes on its hinges, and prevent the return of the blood.

12. The arteries are larger than the veins, and lie deeper in the system, or more removed from the surface. They serve to carry the blood out of the heart, and to distribute the proper nourishment where it is required. The veins are more numerous, and smaller in size than the arteries, and bring the blood to the heart.

13. There was great wisdom manifested by our Maker in locating these different vessels; for if we accidentally cut a *vein*, there is not much danger; but if an *artery* be severed, and the ends are not immediately tied, death will be the result.

14. You will hear physicians frequently speak of "feeling the pulse;" and, for that purpose, take hold of the wrist. All they mean, is, that they wish to know how rapidly the blood passes or circulates, and as the artery at the wrist is nearer the surface than any other, it can be relied on with more certainty, although the blood does not flow through this one, more rapidly than through the others.

15. By palpitation of the heart, we mean that there is some obstruction in the way, which makes the circulation irregular. Our lives and existence depend on the regular circulation of the blood; hence, this palpitation is considered very dangerous. We ought not to

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12. Describe the arteries, and their use. Describe the veins, and their specific purpose. 13. How was the wisdom of our Maker displayed? Do the veins or arteries require the most care, and why? 14. What is meant by "feeling the pulse?" Why do physicians always judge of the condition of the body by the artery at the wrist? 15. What is meant by the palpitation of the heart? Why is palpitation considered dangerous?

breathe the same air the second time; for if we do, it will not then contain sufficient oxygen to produce that change necessary for good blood.

16. In order to have as pure air as possible, we should *ventilate* our rooms, especially those in which we sleep. When the blood is taken from the body, and exposed to the air, it becomes thick, or coagulates; little yellowish particles of fluid arise, which are called the serum; a thick substance is left, which, when washed, loses its red appearance, and becomes white; this is called the fibrine of the blood. It is supposed by many that there is iron in the blood, which gives the red color to these particles; and when some are called iron-hearted, it is said that they have more than the usual quantity.

17. We are, however, at liberty to doubt this if we choose. You have all heard of consumption. This means that the lungs are consumed, or incapable of inhaling a sufficient quantity of air to support life. This disease, which causes the death of many dear friends, is produced by exposure to the cold, wearing thin shoes in cold and damp weather, and by drawing the clothes so tightly around the ribs that they crowd in and destroy the lungs; this might be *prevented* in a variety of cases by proper care and attention.

18. Dr. Harvey, an Englishman, made the discovery of the circulation of the blood in the year 1620. For

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15. Why should we not breathe the same air twice? 16. How can we obtain pure air? What rooms especially require ventilation? What change takes place in the blood when it is exposed to the air? What is the serum, and what is its color? Describe the fibrine and its appearance. What other elements do some suppose is contained in the blood? Is there always the same quantity of iron? 17. What is consumption? How is this disease produced? How can consumption be avoided? 18. Who discovered the circulation of the blood? In what year?

many years he durst not let the public know his ideas and opinions on this subject; and when he did, he was much opposed, very few believing his new principles.

19. Nearly every discovery that has been made in physiology or philosophy has met with very bitter opposition when first introduced. Some will not believe any new doctrine, even when there are light and evidence enough to prove it to be correct, but adhere tenaciously to the old system of things. But Harvey lived long enough to see his principles admitted by the scientific; and though he was much persecuted for many years, yet he had the pleasure to know that he was correct in his belief. Among the many proofs which led him to make this discovery were the following.

20. *First;* If the chest of a cold-blooded animal, a toad or a frog, be opened, the heart can be seen to contract and dilate. Then it remains an instant at rest, and again dilates and contracts, and raises itself a little, the same as in our own bodies, and causes beating. There would be no cause for this expansion and contraction, if the blood did not flow in and pass out of the heart.

21. *Secondly;* Another reason is, that in all the arteries there are valves, which permit the blood to pass into them, but prevent its passage backward toward the heart; also, in all the veins, the valves allow the blood to go toward the heart, but not in the opposite direction;

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18. Did he make his discovery known? 19. How has every discovery in science been received by the public? To what do some always adhere? Was the opposition and prejudice finally removed? 20. What was the first proof of the circulation of the blood? 21. What was the second proof of the circulation of the blood?

which facts alone would clearly prove to every candid mind, that they would not have been constructed in this manner, and so well adapted for the circulation of the blood, unless it were for that specific purpose, and for that alone.

22. *Thirdly ;* It has been said that the circulation of the blood through the veins and arteries may be seen by a microscope—an instrument by which the smallest object may be seen—in some of the delicate parts of different animals, as in the web of a frog's foot.

23. *Fourthly ;* The way in which bleeding from a vein is performed, is another proof of the circulation of the blood. A tight bandage is placed around the arm *above* the place where the vein is to be opened. The blood in returning through it toward the heart, is interrupted in its passage, and as the artery underneath is not compressed, the vein is filled with blood, and is swelled. If the vein be then opened below the bandage, the blood will flow freely ; but if the bandage be tight enough to compress the artery, the blood cannot pass through it from the heart, so there will soon be none in the vein : or, if the opening be made above the bandage no blood is obtained.

24. *Fifthly ;* In the amputation, or cutting off, of a limb, the surgeon ties only the ends of the arteries together. As these carry the blood from the heart to all parts of the body, the patient would soon bleed so as to cause

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21. What should the present construction of the veins and arteries prove clearly ? 22. What is the third proof of the circulation of the blood ? What is a microscope ? 23. What is the fourth proof of the circulation of the blood ? How is bleeding from a vein performed ? What would be the result if the bandage be too tightly bound ? 24. What is the fifth proof of the circulation of the blood ? Why do not the veins require to be tied ?

death, unless some means were taken to prevent it. The veins which carry the blood back to the heart do not bleed, and therefore need not be tied.

25. From these five reasons or proofs of Dr. Harvey, we cannot but believe that the blood passes from the heart, through the arteries, into the veins, and is returned by them into the heart; or, in other words, that the blood continually circulates, or is distributed through our bodies.

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25. To what conclusion should these five reasons of Dr. Harvey lead us?

CHAPTER V.

SECRETION.

1. The word secretion means a separation of fluids. When it is used in physiology, it has reference to a certain process by which various substances are separated from the blood, without being changed in their separation. We call this act of separation secretion; and we also call the substance that is separated secretion; as we say that by secretion the gastric juice is formed in the stomach, and we say also that the gastric juice is a secretion of the stomach. Both are correct.

2. Without secretion there would be no possible way for the different parts of the body to be nourished, and many injurious substances would not be discharged from the blood; therefore it is very important for our health that these secretions should not be interrupted. These substances, though derived and separated from the blood, are very different in appearance and composition from the blood, as we shall see.

3. There are three kinds of organs for the purpose of secretion, which I wish you to remember, when I have explained them to you.

First—The exhalant vessels.

What is the subject of chapter fifth? 1. What does secretion mean? How is the term used in physiology? What two things does this word comprehend? What is an example? 2. What are the advantages of secretion? How important is secretion to health? Are the secreted substances similar to the blood? 3. How many kinds of secretory organs are there? What is the first kind?

Second—THE FOLLICLES.

Third—THE GLANDS.

4. You may recollect that I have informed you that there are a great many little vessels through which the chyle passes over the intestines. These are called capillaries, and it is thought by many that the exhalant vessels, which are very small, are connected with them. These exhalations are internal, when they take place in the body. The head, chest, and stomach are all lined with a thin covering, which throws out a little fluid, sufficient to keep them moist, and enable them to move easily.

5. The *fat*, of which I have heretofore spoken, is caused by exhalation, or is one form of secretion. It is first an oily, greasy fluid, then becomes hard, and serves as a protection to the skin. Then the ligaments around the joints are lined with the same kind of membrane as the stomach; this secretes the *synovia*, which enables the joints to move easily.

6. The *marrow* that is in the long bones is another secreted exhalation. The use of the marrow is not known. Many supposed it were to make the bones less liable to be broken; but there is more of it in the bones of aged than in those of younger persons, and their bones are much more easily broken.

7. The external exhalations are those which take place out of the body. These are the *sweat* or *perspi-*

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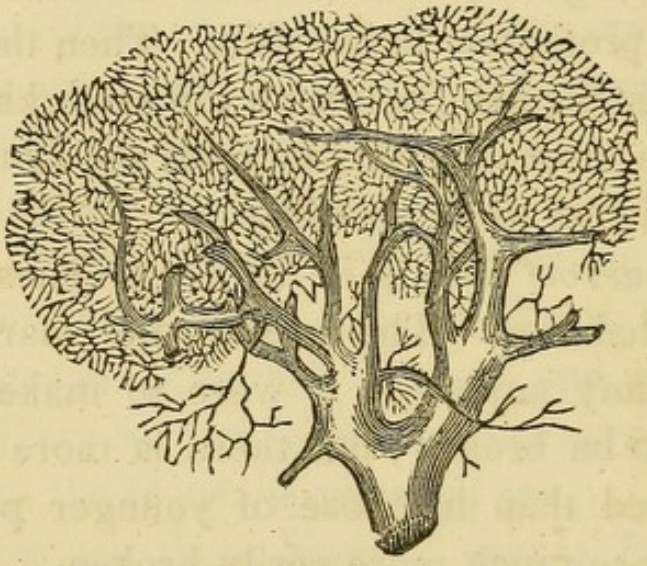
3. What is the second kind? What is the third kind? 4. With what are the exhalant vessels connected? What is meant by internal exhalations? Where are some of the internal exhalations found? 5. By what is the fat caused? How is it formed? What is the synovia, and where is it secreted? 6. What secretion is contained in the long bones? What is the use of the marrow? How do we know that it does not strengthen the bones? 7. What is meant by external exhalations?

ration that is continually passing off, and a little mist or fluid which passes from the lungs.

8. The second division of secretory organs is called FOLLICLES. These are little bags, found in the skin near the surface. They secrete an oily substance. When this does not pass through the pores of the skin, it appears like a little ridge or worm; but if the pores be kept open by frequent bathing, this fluid will pass off as soon as it is secreted. There are follicles in each ear to secrete the *ear-wax*, which will produce deafness if it be not removed. There is a little follicle at the root of each hair; and the difference between the moistness in the hair of different persons depends on the amount of liquid that the follicle secretes.



THE GLAND.

9. The third division of secretory organs, is called *glands*. These are situated in different parts of the

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7. What are some of the external exhalations? 8. What is the second division of secretory organs? What are the follicles? How does their secretion appear? What is necessary for us to do that this secretion may pass off? What does the follicle in the ear secrete? What is one cause of deafness? What is the use of the follicle at the root of the hair? 9. What is the third division of secretory organs?

body, and are of various sizes; some being quite small, others quite large, weighing several pounds, and contain arteries and veins to carry the blood to them and return it again. The substances which the glands secrete differ very much in appearance from the blood, although they are formed from it.

10. It is thought that the elements of all the different secretions exist in the blood; but when different elements are united in different quantities or proportions, the result, of course, is different; for the same reason that a certain quantity of oxygen gas, being united with several different gases, makes air; but if we unite another quantity of the same oxygen gas with other gases, it makes water; so that if two or more elements existing in the blood were united, they would produce tears; while several other elements would make the gastric juice, and so on with all the other secretions.

11. There is, however, a principle of life within us, that regulates all these different operations, that they may produce the desired result. Some of the most important fluids which the glands secrete, are the following: first, the

SALIVA.

12. The saliva is formed by three pairs of glands, situated in the mouth. They secrete the fluid which passes into the mouth through a little tube in the muscles of the face. Its principal use when mixed with the

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9. Describe the glands. Are the substances secreted by the glands similar to the blood? 10. Are these substances contained in the blood? What produces the difference between them? Explain in what way this principle holds true in reference to different quantities of the same gas? 11. What regulates all these different operations? What is the first fluid that is secreted by the glands? 12. How is the saliva formed? How does it pass into the mouth?

food, is to moisten it, and render its passage more easy down the throat. It also makes the voice clearer and better, by keeping it moist. The saliva has no smell, taste, or color, is a little heavier than water, and contains some salt and a little acid.

GASTRIC JUICE.

13. This fluid is secreted in the stomach, and very much resembles the saliva; yet it is more powerful in its operations, and of more importance to us in its use. During the process of digestion, this fluid is poured on the food, and dissolves it into a soft mass, which is called chyme. It has the same effect on the food that rennet has on milk in the process of making cheese. So when little infants throw up their milk from their stomachs in a curdled state, it shows that their stomachs are in a healthy condition.

14. It is nearly tasteless, and without odor, yet it has the quality of preventing putrefaction, and will even remove it after it has commenced. It is said that portions of dead bodies, which become putrid and disagreeable, when taken into the stomachs of some animals, become perfectly inoffensive, and as in a state of preservation.

15. Though the gastric juice possesses those remarkable solvent properties, which enable it to dissolve even the hardest substances, yet it has no power to act on

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12. What is its principal use? What are the properties of the saliva? 13. What is the second secretion of the glands? Where is the gastric juice secreted? In what does it differ from the saliva? What is its use? What effect has it on our food? When do we judge that the stomach of infants are in a healthy condition? 14. What are the principal properties of the gastric juice? 15. Does the gastric juice act on substances having life?

anything that has life. Consequently, worms will live in the stomach for some time, but as soon as they are dead, the gastric juice acts on them and dissolves them. The gastric juice has sufficient power to eat holes through the coating of the stomach; but this is the case only when the person has been some time without food.

16. That digestion is effected in the manner here described, and is also influenced by the gastric juice, has been proved by experiments tried with a young Canadian, who received a wound in his side large enough for his physician to make observations when he took his food. He ascertained how long it required different kinds of food to digest, and the effect of the gastric juice on it, and made various other interesting experiments, which are fully detailed in almost every work on this subject.

BILE.

17. The bile is secreted by the liver, which lies in the right side, just between the ribs, and is the largest gland in the body. It has a brown, yellowish color, is very bitter and thick, and assists in the formation of chyle. Some suppose that the liver acts as a kind of sponge, to absorb all noxious substances in the blood, and throws them out of the system by means of the bile.

18. You sometimes hear that persons have a "*bilious stomach.*" The bile should not be in the stomach; and

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15. When does this fluid act on these substances? How powerful is it at times? When does this take place? 16. In what manner has it been proved that these ideas of digestion are correct? What facts were ascertained by means of this youth? 17. What is the third secretion of the glands? What organ secretes the bile? What are the properties of the bile? What do some suppose that the function of the liver is? 18. Should persons ever have "*bilious stomachs?*" Why not?

this would never be the case if the stomach were always in a healthy state. When oily substances, as gravy, etc., are in the stomach, the gastric juice cannot act on them; so the bile flows from the liver, enters the stomach, and helps to remove them.

PANCREATIC FLUID.

19. This fluid is secreted by the pancreas, a gland situated behind the stomach. This gland secretes a very little fluid, of a yellow color, salt taste, without odor, similar to the saliva. Its secretion is not increased during digestion, yet many suppose it assists in forming the chyle.

TEARS.

20. The tears are secreted by the lachrymal gland, behind and at the corner of the eyes. They have a salt taste, and are inodorous.

21. The above are some of the principal secretions; and, from what has been said of them, you will again see how very important it is to possess good blood; for from this very blood is formed the tears, the gastric juice, the bile, the bones, etc.

22. There are little vessels situated all over the body, one of which has a little fluid to make the finger-nail; another, the joint; another, the bone; one has a substance which helps to give the eyes their beautiful

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18. When is the bile necessary to the stomach? 19. What is the fourth secretion of the glands? What organ secretes the pancreatic juice? What are the properties of this fluid? 20. What is the fifth secretion of the glands? By what are the tears secreted? What are these properties? 21. What is a conclusive reason for us to have good blood? 22. Name some of the uses of the little vessels situated over the body?

color; another, to help form the soft hair; and so on. All these little vessels have their respective office to fulfil, which is done without any confusion, in perfect system and order.

23. Hence we see that the work of secretion is a beautiful system, nicely arranged by our Creator, and should cause us to love and admire that great Being who has formed our bodies, and who sustains us by his goodness and power.

24. What a wonderful body we have to keep in order; just think of the heart, beating, beating, more than one hundred thousand times in a day, month after month, for seventy or eighty years, without once being out of order.

25. Everything in machinery needs to be thoroughly repaired occasionally, however perfect the construction may be. A perfectly finished wheel will not always revolve without being oiled. The most beautiful house needs frequent repairs.

26. But such is not the case with our heart. It is ever faithful to perform its duty, if we are only faithful in taking care of it. It never grows weary, nor falls asleep; but, whether we sleep or wake, it is untiringly at work.

27. Then what a perfect frame-work we have, finished and covered so nicely with skin and muscles! We

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22. In what way do these vessels perform their respective office? 23. How should we regard the work of secretion? What feelings ought it to incite in us toward our Creator? 24. Why should we ever think of our bodies? Is there anything remarkable about our hearts? 25. What is a fact in regard to all machinery? How does this apply to a wheel or a house? 26. Does the same principle hold true with respect to our heart? 27. What nice adaptations are there in our frame-works that should call forth our admiration?

have eyes for seeing, and ears for hearing; we can discern pleasant odors, and we can taste agreeable food. We should surely have feelings of gratitude to our Maker for all that he has done for us, and ought to feel under the greatest obligations to keep all these different parts in order; to imbibe no foolish and evil habit which will weaken the powers of our bodies, or the faculties of our minds. Some have naturally more vitality than others; but all can enjoy a measure of health for many years, if they will but obey the *laws* of health.

28. All organized beings—by which I mean those that have functions or organs to nourish and sustain them—are limited in their periods of existence. The length of life in plants, animals, and man, depends very much on the time which it requires for them to mature. Those which mature or ripen quickest, soonest come to decay; those persons whose bodies are perfected the quickest, die the soonest.

29. The little sapling has to grow many, many years, before it attains to the full stature of an oak; yet, when it is matured, it will live for ages, sometimes for a thousand years. But the annual requires but a few months to bring it to perfection. We plant the seed; in a few weeks the tiny leaves appear, expand, bud, blossom, and the plant dies. The same holds true in regard to man.

Man rarely comes to maturity before twenty or

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27. Under what obligations are we? In what way can all enjoy a measure of health? 28. What are organized beings? Do they always exist? On what does the length of life in man, plants, and animals depend? Explain this fact. 29. What is said of the growth and duration of the oak? In what way does the annual differ from the oak? What is the difference between man and the lower animals in regard to maturity and decay?

thirty years, and his life is proportionately long, being three score years and ten—seventy years—when he takes care of himself; but some of the lower animals attain their full size and growth in a few years, and scarcely ever live over twenty or thirty.

30. In early youth, before the body is matured, the functions of digestion, nutrition, etc., are very active, and are rapidly performed. The brain is larger, and the nervous system is then more developed than in after periods of life. The child eats, his food nourishes his body, and he grows rapidly; but the man eats a much greater quantity of food, yet we can scarcely perceive any difference in *his* stature or size from one year to another.

31. There is a period when the body has attained its full growth, called maturity. When this period is reached, there appears for a little time to be neither progress nor decline. Though there is in our system a power to repair all injuries which the body receives, to heal all the wounds, and to unite all the bones; yet the body will *finally* decay, regardless of all our exertions to guard and preserve it.

32. We cannot see that this decay is necessary from the nature of the body, neither can it arise from the gratification of the artificial wants of civilized life; for savages do not retain their faculties as long as those who are in a civilized state. But it appears to be the

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30. In what condition are all the functions in youth? What is said of the brain and nervous system at that period? What is the effect of the food? Has the food the same effect on the man? 31. What is meant by maturity? What is the condition of the body at this time? Is there anything in our systems to enable us to resist injuries, etc.? Will this power always continue? 32. Do we know the causes of decay? What appears to be one cause?

order of nature, that man should live, then die. When adult life has passed, then the organs begin to decay.

33. The nervous system is first affected; the hearing, sight, etc., grow feeble; the muscles become stiff, hardened, and difficult to contract, so that they cannot well support the body; hence old persons are inclined to stoop and totter, and therefore require the additional assistance of a cane or staff. Then the circulating system begins to decline; bony substances gather around the veins and arteries, and thus interrupt the free passage of the blood. The lungs cannot breathe or inhale the air so well, therefore the blood is not so well purified.

34. These systems become more feeble, till they are no longer able to perform their various offices; then death ensues. Many accidents are fatal, and produce death in aged persons, because their bodies become enfeebled, and can neither assist nor repair injuries as well as in youth. The bones of children easily unite; but in after years there is a want of that strength and vigor, so that when the bones are shattered or injured, the injury cannot well be repaired.

35. Children, I hope by these few lessons and instructions, you will have been incited to think more of the functions of your bodies, and that the older you grow the more you will become interested in this important study. When you see flies walking and balancing themselves on the ceiling, think, and try to find out why they can support themselves there without falling. So

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32. What takes place after adult life has passed? 33. What system is first affected? Why do aged persons require an artificial support? What system next decays? How does this affect the blood? 34. When does death ensue? Why are accidents more fatal to the aged than to the young? What is said in regard to the bones of children? 35. What ought these lessons to incite and encourage in children?

of everything around you. Be not contented to know that things *are* as you see them, but find out the *reason* for the different action, if you can. I hope you will now understand better than you did what physiology means.

30. I will give you another chapter on the instincts of animals, and will then leave this interesting part of the subject, to speak of another part even more interesting, if possible: viz., the brain and nervous system.

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35. Should the mind be contented by observation alone? What should we always endeavor to ascertain? 36. What subject will be next explained?

CHAPTER VI.

INSTINCT.

1. THERE is in many respects a great resemblance or analogy between man and other animals. Some animals exhibit marks of skill, sagacity, caution, or judgment; and, in many cases, the power of reasoning almost equal to human beings.

2. Some suppose that every animal possesses all the faculties with which man is endowed, only in a much more limited degree, modified by circumstances, but not guided by reason.

3. Whether this be correct or not, we know that animals *show* as many of these different talents as it is possible without having the intellect of man. Sometimes they appear to be guided by experience, observation, and even reason. However this may be, they are endowed with a principle that enables them to seek their food, build their habitations, and take care of their young, which is called INSTINCT. They have also the power to vary their means or course of action, in order to accomplish certain ends, when circumstances vary or require this change.

What is the subject of chapter sixth? 1. Is there any resemblance between man and other animals? What do some animals exhibit? 2. What is the opinion of some with regard to the faculties of man and human beings? 3. What certain knowledge have we respecting them? By what do they appear to be guided? With what are they endowed? What is this principle called? When can they vary their means of action?

4. Instinct is that which prompts an animal to act, without teaching from others; to follow a certain course which is best adapted to his wants and condition.

5. The reason of man has been called a "bundle of instincts;" yet there is a wide difference between the powers of men and animals. Man improves from one year to another; his knowledge is the result of experience, observation, and reflection.

6. The dwellings of man differ in different countries and ages, from the hut of the savage to the palace of the king; though man constructed both the hut and the palace.

Beavers build the same kind of houses now that they built many hundred years ago; and so of all other animals; there is no improvement from one generation to another; they always continue the same.

7. Smellie says there are two kinds of instincts; one kind which the animal can scarcely help obeying, without any instruction or experience; and a second kind by which they can accommodate themselves to peculiar situations. and can also improve by experience and observation.

8. I will relate some anecdotes to you, which illustrate these different instincts in some of the different animals; and though it may *seem* to you impossible that these are true, yet I shall mention none except those

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4. What is instinct? 5. What has the reason of man been called? What difference is there between the powers of men and animals? 6. What is said of the dwellings of man in different ages? What is said of the houses of beavers in different ages? 7. How many kinds of instinct are there? What is the first kind? What is the second kind? 8. How can these different instincts be illustrated?

which I *know* to be true by having witnessed them myself, or those related to me by friends who have seen them, or those given by different physiologists as facts. So you may believe them all.

9. Young birds always open their mouths at every noise they hear, because they think it is their mother's voice, and that she is bringing them food. They do not use their wings till they have gained strength, and have observed in which way mother-birds use theirs.

10. Insects place their eggs in the most favorable situations for their young. All those whose young feed on vegetables place their eggs on plants. Those that always live in the water place their eggs on the surface of the water.

11. The wasp builds her nest, deposits her eggs in it, then brings just enough green worms, which she rolls together so that they cannot move, and then leaves them as nourishment for her young. She does not wish them as food for herself, but knows that they are the best nourishment for the little young wasps. Dr. Darwin relates a fact which he saw himself. A wasp caught a fly almost as large as her own size. She cut off its extremities and tried to fly away with the body, but found that on account of a slight breeze, the fly's wings impeded her own flight. She came to the ground, cut off first one and then another of the fly's wings with her mouth, and then flew away.

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8. Will these anecdotes be true or false? From what sources are they derived? 9. What do young birds imagine every noise is? When do they use their wings? 10. Where do insects place their eggs? What kind are placed on plants? What kind are placed on the surface of the water? 11. How does the wasp provide for her young? Does *she* ever eat these worms? Why does she procure them? What anecdote does Dr. Darwin relate of a wasp?

12. Bees exhibit a wonderful sagacity. They choose their queen, and then build their cells, which are very neatly and beautifully constructed. When they increase so much in number that the old hive is not large enough to contain them, they choose their queen, swarm, and seek a new home. If there is not room for all their operations, they increase the depth of their honey cells. Those who wish to find the honey of those bees which have strayed away in the woods, and have built their nests there, catch two bees, carry them to a distance, and then let them fly; each takes the straight line towards the nest or hive, and by observing these lines the hive may be found, in the direction where they cross each other.

13. Sometimes bees stray away and build their hives in the trunks of hollow trees. There was a large tree cut down in a certain place, and near the root a great many layers of honey were found; the bees had probably deposited their honey in it for many years. Bees are industrious insects, and will not permit any drones —those bees which will not work—to live with them, but they all assist each other.

14. The spider and many other insects exhibit a kind of singular instinct. If you touch a spider with your finger, he will run away as swiftly as he can; but if he finds that he *cannot* run in any direction, he draws his feet together, and lies perfectly motionless, feigning to

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12. What sagacity do bees exhibit? When do bees "swarm?" What course do they take when their cells are not large enough? How can we find the honey of those bees who have strayed away into the woods?
13. Where do bees frequently build their hives? How has this fact been ascertained? What is one peculiarity of bees? What is meant by *drones*?
14. What particular instinct does the spider exhibit?

be dead; and if he be even torn by pins, he will not show the slightest degree of suffering.

15. Ants generally make their nests on the ground; but in Siam they build them on trees, because that country is often flooded with water, and people are obliged to build their houses on long poles.

16. There are some birds that always move to a warm climate as soon as winter approaches. They go at a particular time, and return again at a particular season.

When birds have liberty to do as they please, they always build their nests of the same material—the same mud and straw, and in the same spot, year after year.

17. Sometimes they wholly change their mode of building, especially in those countries where snakes abound. The bird hangs its nest on the branch of the tree, and makes the opening to it at the bottom, so that should the snake crawl up the tree to the limb, it could not get into the nest to take the eggs.

18. There is a certain bird that has been seen to catch grasshoppers, and fasten them to the twigs of trees where the little birds were accustomed to come. Why do you think she did this? for she never eats them herself. The reason was this; her instinct taught her that little birds were fond of grasshoppers; and as *she* was very fond of little birds, she put them there

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15. Where do ants build their nests? What is their custom in Siam? For what purpose? What are people obliged to do there? 16. How does the climate affect birds? How do birds generally build their nests? 17. Do they ever change their mode of building? Where does this take place? How does the bird endeavor to avoid the snake? 18. What is the custom of a particular kind of bird? Explain why she does this?

for a bait to decoy and bring them to that place, so that *she* might catch and eat them.

19. A swallow once slipped its foot into the noose of a cord, and by endeavoring to escape, drew the knot tight, so that he could not get away. He raised a most piteous cry, which drew a large flock of swallows around him. When they perceived his condition, each one struck the cord with his beak till it was broken, and their companion was freed.

20. When two goats meet on a narrow ledge of rock over a precipice, and see that there is no room to pass each other, after stopping a moment, one crouches down, and permits the other to walk gently over his back; then each one continues his journey along the narrow and dangerous path. Certainly they show a more accommodating spirit than some men do.

21. There was a certain cat, which frequently went into a closet, the door of which was fastened by a common iron latch. When the door was closed, and she wished to come out, she mounted on the bench of the window, which was near the door, and with her paw lifted the latch, and came out. This she did for many years. Another cat, which lived with a friend of mine, was accustomed to come to the kitchen door every morning, at precisely five o'clock, open the door with her paw, and come into the house.

22. The same family had a dog which would jump and be very uneasy as soon as he saw any of the men in the family put on their coats as if to go out. If they

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19. Relate the anecdote of the swallow? How did the other swallows express their sympathy? 20. In what way do two goats accommodate each other? 21. Relate the anecdote of the cat. What was the custom of another cat?

told him in a quiet tone that he might go with them, he would lie down quietly at their feet; but if they said, you cannot go, he would skulk away under the table.

23. Dogs possess a remarkable degree of instinct, sagacity, or understanding. In Switzerland there are high mountains, the tops of which are always covered by snow. Sometimes the snow falls from them suddenly, in such large masses that houses and travellers are buried. There is a convent among the mountains called the St. Bernard, where the monks keep a particular kind of dog that they send out after a snow-storm in search of travellers, whom they frequently dig out of large banks of snow, and save their lives.

24. There are hunting dogs in Mexico, which assist in catching and killing deer. The weight of the deer is generally six times as great as their own, so that if they should attack them in front they might be killed, or have their backs broken. Instead of this they attack them at the side, or at the back, and when the deer starts to run, the dog throws him over. Some dogs will take a basket, and go every day to market to get their dinner. They can always find their master by smelling his tracks along the ground, even if he is at a great distance, and, if possible, will never leave him.

25. Many interesting anecdotes are related by different writers about the sagacity of the elephant.

When tamed, it becomes the most gentle and obedient

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22. How did a dog exhibit great understanding? 23. What powers do dogs generally possess? What is said of the mountains in Switzerland? What convent is situated there? For what purpose do the monks keep dogs? 24. What is the use of the dogs in Mexico? How do they show great sagacity? In what way can dogs find their masters? 25. What are some of the peculiarities of the elephant?

of all animals. It can be taught to kneel, to have a chariot or any load put on its back, which it carries easily. They sometimes exhibit shame and ambition. They were formerly used to assist in launching ships. A certain one was employed to take a large vessel into the water, but it was too heavy for him. When his master saw that he was incapable to perform his task, he said, "take away the lazy beast, and bring another." The creature heard this, and made another effort, but broke his skull, and died on the spot.

26. In a certain city, an elephant, in passing along the streets, put his trunk into the window of a tailor's shop, where several people were at work. One of them pricked the end of it with a needle; the animal passed on as if he did not perceive the insult; but when he came to a puddle of muddy water, he took some in his trunk, went back, and threw it all over the men, and spoiled their work.

27. An artist in France wished to paint the elephant with his trunk raised in the air, and his mouth open. So a boy was employed to throw fruit into his mouth, to keep him in this position; but, as he frequently deceived him, he at last became angry, and one day took some dirty water in his trunk, and threw it all over the painter's picture, as if he knew that this was the most effectual way by which he could vent his spite.

28. A child that could not walk was left to the care of an elephant; as soon as the child crawled to the

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25. What feelings do they sometimes exhibit? For what were they formerly used? How did unkindness affect one? 26. Relate the anecdote of the elephant and the tailors. 27. Relate the anecdote of the artist and the elephant. Why did the elephant spoil the picture instead of insulting the boy?

extent of the elephant's chain, he would quietly lift it with his trunk, and replace it in the spot where it was first left. They formerly went to the battle-field with the Burmans to help them carry on their war. When an extra task was to be performed, some favorite dainty was held out to the elephant before the time; and he, as if aware that his success would be rewarded, made double exertions to earn it, and please his master.

29. The beaver is also a very remarkable animal. In countries where they abound, they gather together in large companies, and in the summer make excursions into the woods to choose the trees they wish to use in building their huts. They select a spot in a lake or river, and then gnaw down the trees; and they always gnaw them in such a manner that the trees will fall into the river.

30. They build their houses large enough to contain from fifteen to thirty beavers. Each cabin has two doors—one on the side of the land, and one leading to the water, so that they can either go ashore or swim in the water. They plaster their cabins with a strong cement of mud, using their flat tails to smooth it. Their houses are very strongly built, and can resist strong winds, and currents in the streams. Sometimes they have paths under the ground, where they can retreat when any danger approaches.

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28. What care will they take of children? Of what assistance were they to the Burmans? In what way can they be incited to make exertions? 29. What remarkable traits has the beaver? In what way do they gnaw the trees for their huts? 30. How large are their houses? How many doors do their cabins have? What is the design of having two? How do they plaster their cabins? For what purpose do they have paths under the ground?

31. The ostrich is the tallest and swiftest of all animals. When it is chased it throws stones and gravel with its feet at its pursuer.

32. Oysters throw water out of their shells when they are attacked, as if to vent their spite against their enemy.

33. A certain pony would open the latch of the stable door, and raise the lid of the corn-crib, which he learned to do himself.

34. Monkeys possess a high degree of instinct, and resemble man more than any other animal. The teeth and paws are very much like our teeth, hands, and feet. In their wild state they live in the woods, on the trees, and feed on fruits, leaves, and insects. They live together in companies, and never go alone when they wish to rob an orchard, or find their food. It seems as if they laid regular plans; for, as has been remarked, part of them stand to watch the approach of enemies, and part enter the field. They form a straight line, reaching from those within, to some place beyond which is a retreat for them.

35. When they are all arranged in due order, those in the orchard, near the trees, throw the fruit to those outside as fast as they can gather it. These pass it over to those nearest to them till the fruit is all nicely lodged in their hut or retreat. If the one who acts as

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31. How does the ostrich compare with other animals? How does it defend itself when chased? 32. How do oysters defend themselves when attacked? 33. What is related of a certain pony? 34. What do monkeys possess? In what do they resemble man? How do they live when in a wild state? What course do they take when they wish to rob an orchard? Do they live alone or in companies? 35. How do they proceed when they are all arranged in the orchard? How are they warned of the approach of danger?

sentinel perceives any one coming, he makes a loud noise, and they all run away ; yet, even then, they will take some fruit under each of their arms or fore-paws, and also in their mouths.

36. They are mischievous animals, and annoy travellers exceedingly by throwing stones and sticks at them ; and they will frequently follow them for some distance, when they are passing through the woods, by leaping from tree to tree. They are capable of forming strong attachments even with other animals, and then exhibit mildness, affection, and docility.

37. Monkeys and orang-outangs can be taught to do almost anything that we can. They ride on ponies, feed themselves with a spoon, and appear to understand what is said to them. The great naturalist, Buffon, speaks of one orang-outang which would present his hand when any one came to see him, and would walk along with great composure. He would sit down at the table, unfold his napkin, wipe his lips, and use a spoon or a fork to convey the food to his mouth.

38. When he was asked to drink tea, he took a cup and saucer, placed them on the table, put in the sugar, poured out the tea, and allowed it to cool before he drank it ; all of which he performed by the signs or orders of his master. Another would, by signs, make the servant understand what he desired ; if his wishes were not granted, he would bite him and throw him

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35. What effect does the warning have? Do they run and leave all their fruit behind? 36. How do monkeys annoy travellers? What is said of their attachments? 37. What are some of the things that monkeys and orang-outangs can be taught to do? What interesting facts does Buffon relate about an orang-outang? 38. How did this animal drink his tea? In what way did he understand his master's wishes? What other facts can you relate about these animals?

down. When he was sick he was bled, and ever afterward, when at all unwell, would hold out his arm to be bled, just as if he understood that he had been relieved by such an operation before. They sometimes carry water from the river in pitchers placed on their heads. Frequently when the pitchers are not taken off, they fall and break, at which the orang-outang moans greatly.

39. I might tell you many more interesting facts and anecdotes about the habits of animals. We find they seem almost to possess the intellect of human beings. This appearance of intelligence has been called, by nearly all physiologists, instinct. Yet when I speak of the elements of our own minds, you will see that animals possess some of these same elements; and I will then attempt to explain from what they arise.

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39. What do animals seem to possess? What is this called by physiologists?