

which was attached to the stem of the lamp itself. Then she sat down at the table, by the light of a great lamp which was burning upon it, and took out her work.

Rollo's father then repeated to her what he had just been telling Rollo, namely, that different substances took fire at different degrees of heat; and he said that it would be a very interesting experiment to take a long iron bar, and put a small quantity of several different substances upon it, in a row, and then heat the bar gradually, from end to end, all alike, until it was very hot, and so see in what order the various substances would take fire.

"I would have," said he, "phosphorus, sulphur, sawdust, charcoal, saltpetre, oil,—we should have to make a little hollow in the iron for the oil,—alcohol, spirits of turpentine, and perhaps other things. The phosphorus would take fire first, I suppose, and then perhaps the sulphur, and others in succession."

"Well, father," said Rollo, "I wish you would. I should like to see the experiment very much."

"No," said his father, "I cannot actually try such an experiment as that. I could not get such a bar very conveniently; and, if I had the bar and all the substances, I could not heat the bar exactly equally. It could not be done very well, except in a chemical laboratory. But it would be a very pretty experiment, if it could be performed."

"Is there a very great difference," said Rollo's mother, "in the degree of heat necessary to set fire to these different things?"

"Yes," said Mr. Holiday, "I believe the difference is very great. Phosphorus inflames below the heat of boiling water, but it takes almost a red heat to set wood on fire. And iron will not take fire till it is white hot."

"Iron?" said Rollo, with surprise.

"Yes," said his father, "iron will take fire and burn as well as wood, if you heat it hot enough."

"I never knew that," said Rollo.

"The ends of the tongs and of the anvilons do not burn," said his father, "simply because the fire is never hot enough to set such a large piece of iron on fire. But if we heat the end of a bar of iron very hot indeed in a furnace, it will take fire and burn; and so, if we take a very minute piece of iron, as big as the point of a pin, a common fire would be sufficient to heat that hot enough to set it on fire."

"Well, father," said Rollo, "let us try it."

"If we had some iron filings, we might sprinkle them in the fire, or even in the flame of a lamp, and they would burn."

"I wish I had some filings," said Rollo.

"Yes," said his father, "they burn beautifully."

"How can I get some?" asked Rollo.

"You can get some at a blacksmith's shop," said his father. "The filings commonly accumulate behind the vice, and you can get plenty of them there. The next time you go by a blacksmith's shop, you had better go in and ask him to give you some."

"Well," said Rollo, "so I will."

"And now do you understand," said his father, "why it is that you can light a lamp more easily when there is a little spirit of turpentine on the wick?"

"Yes, sir," said Rollo. "The spirit of turpentine need not get so hot before it catches fire, and so you don't have to hold the lamp-lighter so long, and burn your fingers."

"Will oil always take fire when it gets to a certain degree of heat?" asked Rollo's mother.

"Yes," said his father, "I suppose so."

"And yet," said she, "the lamp seems to take fire much more easily at some times, than at others."

"Yes," said Mr. Holiday, "that is true. If the wick is cut square across, and rises up only a very little way above the tube, it is very difficult to light it, because the tube itself and the oil below keep the upper end of the wick cool. It is very hard to heat it, in that case, hot enough to set it on fire. But if the wick projects considerably out of the tube, then it is out of the way of the cooling influence of the metal, and you can heat the upper end more easily."

"I never thought of that," said Rollo.

"That is the operation of it," said his father. "And if you push the wick open a little, so as to separate some of the fibres of it from the rest, then it will take fire more easily still; because the small part which is separated, is more easily heated up to the necessary point, than it was when it was closely in contact with the rest, and so kept cool by it. That is the reason why a thin shaving takes fire so much more easily than the outside of a large piece of wood. The outside of a large piece is kept cool by the

parts of the wood behind it, which touch it, while the shaving is heated through very soon."

"I didn't know that before," said Rollo.

"In the cities," continued his father, "the lamp-lighters, that trim and light the street lamps, always cut the wick off, when they trim the lamps, in a slanting direction, so as to leave a point of the wick projecting up on one side. This point will light very easily, for it stands by itself, somewhat apart from the rest, and so is not kept cool by the rest of the wick. Then, when they put in their great blazing torch, it heats this point to the degree necessary to inflame the oil very easily."

"There is one thing more I want to tell you, and that will be all I have to say about lamps to-night; and that is, to explain to you the philosophy of putting them out. You must understand that two things are necessary to carry on combustion or burning. First, there must be air; and, secondly, the body burning must be kept above a certain degree of heat. Now, if you either suddenly shut off the air from the substance that is burning, or suddenly cool the substance, it will go out. For instance, the wick,—you have to heat it to a certain degree before it will take fire. Now, if, after it is burning, you suddenly cool it below that degree, it will go out; or if you shut out the air from it, then it will go out; for it cannot burn unless it continues hot, and unless it continues to have a supply of air."

"Now, when we blow out a lamp, we stop the burning by cooling it. The cool air which we blow against it, suddenly cools the upper end of the wick below the point of combustion, and so it goes out. On the other hand, when we put it out by an extinguisher, we stop the burning by means of shutting out the air. Either mode will stop the combustion."

"And how is it when we put on water?" asked Rollo's mother.

"Why, that is somewhat different from either," said Mr. Holiday; "or rather it is both combined. There is something very curious in the operation of water upon fire; that I must explain some other day, for now it is time for Rollo to go to bed."

AGRICULTURE.

Fat Animals and Large Crops, result alike from an abundance of Proper Food.

The profits of Crops, as well as of cattle, depend mainly upon the return they make for the food and labour bestowed upon them. The man who grows a hundred bushels of corn, or makes a hundred pounds of meat, with the same means and labor that his neighbour expends to obtain fifty bushels, or fifty pounds, has a manifest advantage; and while the latter merely lives, the former, if prudent, must grow rich. He gains the entire value of the extra fifty bushels, or fifty pounds. This disparity in the profits of agricultural labor and expenditure is not a visionary speculation—it is a matter of fact, which is seen verified in almost every town. We see one farmer raise 80 bushels of corn on an acre of land, with the same labor, but with more foresight in keeping his land in good tilth, and feeding better his crop, than his neighbour employs upon an acre, and who does not get 40 or even 30 bushels. This difference results from the manner of feeding and tending the crop.

If the farmer, for the convenience of transportation to market, wishes to convert his grain, and his forage, and his roots, and his apples, into beef and pork, what is his judicious course of proceeding? Does he dole these out to his cattle and his hogs in stinted parcels, just sufficient to sustain life, or to keep them in ordinary plight? No. He knows that a given quantity of food is necessary to keep them as they are, and that the more, beyond this given quantity which they can transform into meat, and the sooner they do it, the greater the profit. To illustrate our remark: suppose a hog requires twenty bushels of grain to keep him in plight for two years, and that he can manufacture fifteen bushels of this grain into pork in six months, if duly prepared and fed to him. In the one case, the owner has his lean hog at the end of two years for his twenty bushels of grain; in the other, he has converted fifteen bushels of this grain into pork—into money—at the end of six months, saved the keep of the hog for eighteen months, and twice or thrice turned his capital to profit. Time is money, in these as in all other things appertaining to the farm. The proposition may be thus stated,—that which will barely keep a hog two years, will fatten him well in six months. Therefore, the sooner we can