The "Patuxent" is an ocean-going twin-screw tug, 148 feet in length, 755 tons displacement, 1,160 horsepower, and estimated speed of 13 knots. A large bunker capacity, twin screws, and unusual speed make her an exceedingly valuable vessel, and she will undoubtedly prove a very serviceable addition to the new navy.

Correspondence.

Electrocution of Animals.

To the Editor of the SCIENTIFIC AMERICAN:

In reference to an article in the July 11 number of your journal, concerning the humane slaughtering of animals, I wish to call your attention to the fact that all the devices offered, at least all those mentioned in the article, for the solution of the problem seem to be of the mechanical order. Why is electrocution not made use of? In slaughtering upon a large scale, it appears to me that electrocution would afford more advantages than the use of any mechanical device, besides being humane enough for the requirements of the A. S. P. C. A. What could be more rapid than the quick application of a high-tension current?

Sherburn, Minn. WALTER ARP.

The Meaning of "Micro-photograph."

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to call your attention to the misuse of the word "micro-photograph" in legends on illustrations on pages 56 and 57 of your July 25 issue.

A micro-photograph is an ordinary photograph minimized to about the size of a pin-head for viewing under a compound microscope.

A photo-micrograph (which is what you show) is a photograph through a microscope of a magnified view of a microscopic object. Of course, I admit there is some "authority" in the misuse of the word as you use it; but in the interests of photo-micrography, I beg you to use the correct or better word. Even if there is sanction of your use of the word, it is illogical. What you want to express is not a *micro*-photograph, but a photograph of a micro-object. The photograph may be as large as the side of a barn.

EDWARD F. BIGELOW.

Stamford, Conn., July 27, 1908.

A Young Girl's Theory of Thunder Storms.

To the Editor of the SCIENTIFIC AMERICAN:

Can a twelve-year-old girl be scientific? Surely not. But I love to think and talk about such things; and who knows but that some day, kicking about in the dust, I may find a nugget as well as a man might. The following notions about the causes of rainfall I think to be new. They are interesting to me, also to some others, among them Prof. Loveland, of our State University, and I surmise they may some time be proved correct:

I, one day, during a thunder storm, said to my father: "What causes thunder?"

He replied: "It is the detonation resulting from a bolt of lightning leaping from cloud to cloud or from a cloud to the earth."

"Yes; we understand that is *what* it is. But what causes it?"

"Well, electricity is generated, in some way not clearly explained, by the condensation of vapor into rain."

"Did you, when a student, see any experiments in which condensation of moisture generated electricity?"

"No; I never did, but I have seen the exact opposite. I have seen water decomposed by electrolysis, i. e., an electric spark passed through water will resolve it into its con ponents, oxygen and hydrogen."

"Then, by the law of conservation of energy would not the reuniting of these component gases into water give back the electric spark that separated them?"

"Yes, I presume it would, though I have never seen any demonstrations to this effect."

"If such prove the case would it account for lightning and thunder?"

"No; not as we understand it. To account for lightning and thunder in this way would involve us in accounting for rainfall by chemical reaction—an entirely different theory from that which now obtains."

"What is the present theory of rainfall?"

"Why, simply this: The point of saturation of cold air is much lower than that of warm air. Hence, when saturated air becomes cooled it precipitates moisture in the form of rain."

"Did you ever see this done in a laboratory?"

"Yes. Often and in many ways. The sweating of a pitcher of ice water in a warm room attests it, also the mist falling from the exhaust steam of an engine on a cold day."

"Did you ever see water recomposed from its constituent gases?"

"Yes. You put them in an inverted bell jar and explode them and water moistens the table. We also see the same in the water dripping from the oxy-hydrogen blowpipe."

"Is the explosion attended by noise?"

"Oh, yes. It cracks like thunder and bursts the bell jar in a thousand pieces."

"Does it give off an electric spark?"

"It may. I never tested for it."

"Could rainfall be accounted for by a chemical reaction like that which bursts the bell jar, lightning being its liberated energy and thunder its detonation?"

"Probably not; though it is a novel and fascinating idea. The soft, thunderless rains of our winter season and those of the Pacific coast are doubtless the result of condensation only, as popularly supposed. But you lead me to think there is room for speculation as to the origin of the thunder shower. At any rate it is an interesting theme. Hunt it down as Kepler did his Laws of Planetary Motion and see if it fits the conditions."

And so I have been, and still am, "hunting it down," and the following is my catechism as far as formulated:

Q. What is the source of the free oxygen in the air presupposed by my theory?

A. All oxygen in the air is free oxygen. Air is a mixture, not a chemical compound.

Q. What keeps up the supply of oxygen if large quantities are consumed in the formation of rain?

A. The exhalation of plants in the process of growth. They inhale carbon dioxide, secrete the carbon, and exhale the oxygen.

Q. Then we would expect more oxygen and more rainfall in districts where vegetation abounds?

A. And such is the case; also more thunder and lightning.

Q. We would also expect fewer thunder showers in winter than during the summer months with their oxygen-exhaling verdure.

A. It rarely thunders in winter, or in arctic latitudes, or after frost has checked vegetable growth in the fall.

Q. Why does a thunder shower seem to follow a watercourse?

A. The vegetation, and hence the free oxygen, are more abundant along the valleys and watercourses. The rain cloud builds itself as it goes, and builds in the channel where the materials exist most abundantly.

Q. In what way does cultivation of the soil and the planting of trees increase rainfall?

A. Besides the physical results usually ascribed, it increases vegetation and the free oxygen which vegetation supplies.

Q. Is oxygen more abundant preceding a thunder shower?

A. Yes. It sometimes becomes so abundant as to compose a new element, ozone or compound. oxygen, which is found in the air just preceding and during a thunder shower.

Q. Is there free hydrogen in the air?

A. Yes, but in quantities disappointing to my theory.

Q. Can this dearth of hydrogen be accounted for?

A. Yes. Hydrogen has a density, or specific gravity only one-fourteenth that of air. Hence, free hydrogen in any quantity would be found in altitudes far above the air strata to which man can gain access.

Q. If so far above the earth, how would it get in contact with the oxygen?

A. Air currents would mingle them.

Q. Do winds, then, conduce to rainfall?

A. Most certainly, especially variable winds. This is obvious to all observers.

Q. But gases mingle together freely regardless of specific gravity; and so, if there were hydrogen in the air it would also be present at sea level?

A. It is present in small amounts in all natural atmosphere. Also the free diffusion of gases is only a partial fact. Carbon dioxide, for instance, will accumulate in wells and mines by reason of its greater specific gravity. It may also be poured from one vessel to another in the presence of the atmosphere and only slowly becomes diffused through the air. And yet its specific gravity is twelve times nearer that of atmospheric air than is that of hydrogen gas.

Q. How can we account for the large quantities of hydrogen in the air which my theory presupposes?

A. The only source I can suggest is the electrolysis of water. The force of the average thunder bolt, expressed commercially, is about $1,400, or equal to the oxidation of a thousand tons of coal at mine value—an enormous aggregate force. Water is one of the best natural conductors of electricity. Hence, lightning usually strikes in water or damp soil and its force, probably, is mainly spent in electrolyzing water and liberating hydrogen which would rise to the upper air immediately, while the oxygen would mingle with the air, which is of about the same specific gravity.

Q. My theory would lead us to expect an accelerated precipitation of rain following at each clap of thunder?

A. Yes. This is a universally noted fact. The freshening shower following a clap of thunder is the best and most direct proof of my theory. Some have tried to account for this by the jar imparted to the atmosphere, and in times of drought have bombarded the heavens in a vain and foolish effort to "jar the rain loose."

Q. If my theory be correct thunder is not the result of lightning. Why, then, do the two phenomena occur simultaneously?

A. Neither is the result of the other. Thunder and lightning are the twin results of a chemical reaction. The best evidence of this is the fact that, while occurring simultaneously, their evidences do not reach us simultaneously, for light and sound do not travel with equal velocity. A flash of lightning, however near us, reaches the eye before the thunder reaches the ear.

Q. Is it not more rational to say that the thunder is the snap of the electrical spark, so to speak?

A. Not at all. One sometimes sees the bolt of lightning and hears its snap or crackle, the detonation of the explosion that gave rise to both reaching the ear a second or two later.

Q. These explosions, when occurring near the earth, would be manifest in their damage to life and property?

A. And so they are. People and animals "struck by lightning" as we commonly call it, are often scorched and singed as if by an explosion of gas and are usually killed without being mangled or torn as we would expect if actually struck by a bolt of lightning. Also buildings are sometimes shattered and not fired; and at other times are fired but not shattered. A tree when struck by lightning is usually splintered, but I never saw evidences of burning in the channels cut by the lightning. On the other hand we often see trees inexplicably killed or the foliage scorched and killed without other evidences of lightning—two distinct classes of damage, one purely electrical, the other a shock and burning, the direct result of being within the zone of the oxy-hydrogen explosion.

Q. What of barometric pressure?

A. Since an unusual infusion of either hydrogen or oxygen, or both, would reduce the specific gravity of the air, my theory would harmonize perfectly with the low barometer preceding rain storms. Even though these gases should be present only in the higher altitudes, yet the barometer would record the lower pressure at all altitudes.

I have other questions yet to answer. I should like someone better equipped than I to discover for me the following, all of which my theory requires should be answered in the affirmative, and I ask them to write me what they discover or conclude, viz.:

1. Is there less free oxygen after than before a thunder shower?

2. Does free hydrogen become more abundant in the air as we ascend from the earth?

3. Is oxygen less abundant after a thunder shower on land and more abundant after a thunder shower at sea?

4. Does the explosion of oxygen and hydrogen gas in a bell jar give forth an electric spark?

5. If correct that electrolysis results when a bolt of lightning passes into the ocean, river, or damp earth, in what other way (than the one supposed by my theory) has the hydrogen gas thus liberated during the ages been taken up and the equilibrium of the air restored?

I do not dogmatize on this theory. I am too little gifted and too poorly equipped with knowledge of the commonest things. I expect some chemist or physicist to fulminate some little fact into my theory that will resolve it into gas thinner than those with which it deals. I am entirely willing he should do so. But if he should not? What then? I only ask that he give me notice when he shoots. EDITH E. CUMMINGS.

Beatrice, Neb., June 29, 1908.

The petroleum pipe line between Baku and Batoum worked without a hitch during the year 1907. The only objectionable feature in connection with the enterprise now is, that in view of the decrease in the exports of illuminating oils from Batoum, there is not sufficient oil to keep the pipe line and its costly machinery continually at work, and the undertaking is, therefore, not as remunerative to the State Railway as was anticipated when the scheme for laying the line first came under the consideration of Russian government engineers. Besides this, merchants using the pipe line are subjected to a loss of 2 per cent of oil which the railway authorities deduct for leakages. Considerable loss of oil is also experienced through the tapping of the line by natives, who in many cases have been caught clandestinely drawing off oil. At Elizavetpol, for instance, quite recently a gigantic fraud was discovered. The town having only consumed one tank car of oil during 1907, an inquiry was instituted which elicited the facts that the pipe line had been tapped some miles to the east of the town, that a systematic robbery of petroleum had been taking place all the year, during which as many as from ten to twelve cart loads of oil were nightly drawn out of the pipe and conveyed to the town for disposal at retail during the day.