Science.

Edited by W. H. Jenkins, B.A., Science Master, Owen Sound Collegiate Institute.

PHYSICS.

QUESTIONS FOR PRIMARY STUDENTS.

1. (*a*) State how you would show that the condition of matter is changeable.

(*b*) What properties are common to all conditions of matter?

(*c*) How would you show, experimentally, that air possesses each of the properties mentioned in part (*b*).

2. (*a*) A barge is loaded with coal, which is carefully covered, and leaves Cape Breton for Rio Janerio. Is there any difference in the water level on arriving at port? Why?

(*b*) State how the weight of a body may be diminished without causing it to lose matter.

3. (*a*) Give separate proofs that gases, liquids and solids must be composed of very small particles. What are these particles called?

(*b*) Give experiments which indicate that gases and liquids when apparently at rest outwardly are not so internally.

4. State how you would use each of the effects produced by the electric current in determining the magnitude of the cause.

5. What determines the strength of a voltaic current? Upon what factors does each determining cause depend?

6. Arrange two Bunsen cells in series, and two Daniell cells in multiple-arc, and join both sets. How would you test the presence of a current. Show by drawings the construction of a Bunsen and a Daniell cell.

7. Indicate by a diagram the construction of a Tangent galvanometer and an electric bell.

AGRICULTURE.

ANSWERS TO QUESTIONS AT THE PUBLIC SCHOOL LEAVING EXAMINATION, 1892. (FOR QUESTIONS SEE JOURNAL OF FEBRUARY 15TH).

1. (*a*) Oxygen—A colorless gas, somewhat heavier than air, odorless. Almost all substances will burn brilliantly in an atmosphere of this gas if they have been previously heated.

Nitrogen—An invisible gas, odorless, very slightly soluble in water, about the same weight as air, prevents burning. Animals placed in an atmosphere of this gas would die.

Carbonic acid gas is also an invisible, odorless gas, considerably heavier than air, quite soluble in water, extinguishes flames and destroys animal life.

Ammonia gas—invisible, a sharp, pungent, irritating odor, extremely soluble in water, lighter than air.

1. (*b*) One hundred quarts of air contain, approximately, seventy-nine quarts of nitrogen, twenty and a half quarts of oxygen, one-twentieth of a quart of carbonic acid gas, and the balance of ammonia gas and water vapour.

2. "Soil" is a mixture of very fine particles of rock matter of various kinds, with remains of animal and vegetable life, the whole forming a mass that has comparatively little adhesion, thus enabling it to be easily worked by various instruments.

It is formed by the action of rain on solid rocks, gradually wearing them down to fine particles; by rivers which act much in the same way; by frost which expands crevices and splits off bits of solid materials; by the wind driving small particles over one another thus, by friction, making them smaller; by plant life which on decomposing forms acids which eat away the solid particles.

3. Drainage improves the soil by removing an excess of water, thus allowing the air to penetrate it better. Air, in many cases, can convert injurious materials in.o forms which are useful to the plant. Drainage also removes any injurious materials which may be present.

Ploughing and subsoiling loosen the earth and allow the air, rain and rootlets of plants the better to penetrate it. In case of drought, plants on well ploughed land are enabled to go deeper and thus secure water and additional nourishment. Subsoil ploughing also renders the subsoil more fit to be brought to the surface for plant nourishment; it also prevents the accumulation of injurious materials in the subsoil.

4. Rotation of crops is beneficial because each plant requires certain special foods. If the same crop is repeatedly sown on the same field it soon exhausts the soil of those foods, and unless the field is manured with material containing the same foods the crop fails, but a crop of another plant might find the food it requires. Certain crops also require different mechanical treatment of the soil from other crops. Suitable rotation, therefore, provides that the whole farm will be carefully and thoroughly worked.

5. Soiling is the preparation of the earth for the profitable growth of a crop, and comprises not only thorough working but complete manuring. Among the benefits are, first, the general one of loosening and rendering the soil friable and penetrable; second, supplying those foods to the soil which the special crop requires; thus ensuring a good crop and preventing exhaustion.

6. Weeds abstract from the soil much food which should go to nourishing crops. Being more hardy they often exclude other plants.

Canada thistle may be subdued by growing a crop such as clover or hay, which largely exclude it, or by summer fallowing.

Wild mustard should be plucked before coming to seed; the seed grain should be carefully examined; do not have a threshing machine from a farm where mustard is known to exist. Certain solutions will prevent the germination of the seed. Couchgrass is best removed by reploughing.

THE PRACTICAL STUDY OF A FERN.

Make a drawing one-half natural size of the complete plant. A specimen from the school herbarium will supply the material for this work if a fresh specimen is not at hand. Draw also the under side of the frond. Name all parts.

The Leaf. (*a*) Draw one of the pinnæ magnified two or three times, showing the under and upper surfaces, and indicating carefully the venation.

(*b*) From a growing plant, or from an alcoholic preservation, pluck one of the pinnæ, wrap around the fore-finger and with a sharp razor take a small cutting parallel with the upper surface and as thin as possible. Mount this section in water on a glass slide, examine first with low power and then with high power, making drawings.

(*c*) Repeat part (*b*), taking the section from the under surface. Name the kinds of cells shown and indicate other structures observed.

(*d*) Make a cross section of the pinna through the midrib, being careful that the section through the midrib is very thin. Several attempts will be necessary before success is attained. Mount and draw. Name all the tissues and kinds of cells observed. If you have difficulty in naming the cells of the midrib in cross section, take off a small portion of the rib, place with water on a glass slide and with two sharp needles with wooden handles separate the rib as much as possible, then cover with cover glass and examine. Draw.

The Stem. (*a*) Obtain from a florist a frond of a fern, if the season does not permit you to get a fresh specimen from the woods. Make a thin cross section of the stipe, and mount. Make also a thin longitudinal section of the same and place the latter on the slide just below the first. Cover both and examine. Indicate the corresponding parts in the two sections.

The Rhizome. Make sections of this as in the case of the stem. Examine, draw, and compare closely with your drawings of the stipe.

The Fruit. (*a*) Obtain a fern in fruit. Select a pinna with fruit-clusters. Draw the whole pinna, correctly locating the fruit-dots. With a good hand lens observe a cluster and draw.

(*b*) With a sharp knife detach one of the clusters, place on a glass slip with water, and examine with low power.

(*c*) Tease apart, in water, on the slide, one of the clusters, cover, examine and draw.

(*d*) Examine a spore with the highest power you have.

If you have ample time and can secure a few spores just matured, sow on a damp piece of pottery, keep moist, and after a time examine For this part of the work, however, it would be better to consult some standard textbook.

If the herbarium provides several species of ferns, it would be excellent practice to examine each, comparing with your drawings, and noting the chief classificatory structures.

Go over all your drawings carefully, with a good text-book in hand. Have a clear idea of the whole plant before you leave it.

CORRESPONDENCE.

M. N. (Frankville). Q.—Does sound travel as fast at the latter part of its course as at the first?

Ans.—Yes, provided the conveying medium does not change in elasticity or density.

Q.—Is there any assigned cause for the collection of unignited gas in the centre of a flame?

Ans.—The process of burning of a gas consists in union, chemically, with oxygen; consequently the outer layers of gas are supplied freely with atmospheric oxygen, while the central part of the flame cannot receive it. The Bunsen burner provides for a better intermixture of oxygen and the gas before ignition.

An old subscriber (Massie). Q.—What work would you recommend to read on Zoology for Matriculation?

Ans.—In preparing for the Matriculation Examination in Zoology, a practical knowledge of each of the leading Vertebrate and Invertebrate types is required. This can be obtained only by dissection. Huxley and Martin's Practical Zoology will give full and explicit directions for this. After practically dissecting the types with the aid of this text, you will be prepared to use the H. S. Zoology with profit. You will also find further information in the following numbers of The Journal: June 15th, July 15th, September 15th, November 15th, 1892, and January 15th and the present number

Bessey's Botany is a first-class work, and for preparation you couldn't do better than have a copy.

INTERESTING NOTES.

RADIATION THROUGH VACUA.

The experiments of Professor Dewar upon the effect of high vacua on the radiation of heat, undertaken in the course of his researches with liquid oxygen, lead to some interesting considerations that may cause us to modify, entirely our conception of radiation of the sun's heat. It has been usually taken that the long heat waves, as well as the short light waves, came direct by radiation from the sun, and that consequently an enormous amount of energy was continually being dissipated. But Professor Dewar's experiment tends to show that an absolute vacuum is entirely impervious to low waves of heat radiation. Interstellar space, therefore, though transparent to light radiation, does not presumably convey heat radiation at all, and the heat waves manifest in the atmosphere are created there. We see in this the necessity for remodeling our theories upon the time required to cool the earth down; for, if space is impervious to heat radiation—as is Professor Dewar's vacuum—we need not fear cooling on this account. The interstellar space has lost one of its properties, and at a stroke, by a simple experiment, a huge proportion of the supposed available energy of the solar system disappears.—*Scientific American.*

ICE.

The molecules of ice are bound together by a very great force. To separate them, that is to melt say one pound of ice at 32° F., requires a power of 109,396 foot pounds, or a power equal to lifting the ice to a height of over twenty miles, or the exertion for one minute of over three horse power.

PHYSICS IN FRANCE.

At the chemistry exam.—"Which is the best known insulator?" The candidate, a young student, pale and thin, with a bilious complexion and a savage look about him—"Poverty, sir."—*La Monde Illustre.*