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The Canada School Journal.

AND WEEKLY REVIEW.

VOL. X. TORONTO, SEPT. 17, 1885. No 33.

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The Canada School Journal and Weekly Review.

An Educational Journal devoted to the advancement of Literature, Science, and the teaching profession in Canada.

—o—TERMS.—o—

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The World.

One of the foulest blots on the later pages of United States history will be the outrage recently perpetrated on the Chinese at the mining district of Rock Springs, Wyoming. The mining company had imported a large number of Chinese to take the place of discharged whites. About 150 white miners, armed with guns, attacked the Chinese quarter, set it on fire, shot down in cool blood some forty or fifty of the unresisting fugitives, and drove some five hundred of them to the adjacent hills to starve. A more cowardly and brutal deed can scarcely be conceived. Suppose the victims to have been Americans in China and their murderers Chinese, what would the great Republic say and do?

The September bulletin of the Ontario Bureau of Industries shows that the fall wheat crop of the Province is excellent reaching the high average of 24.3 bushels per acre, and indicating a total product of 21,280,543 bushels. The spring wheat has been unfortunately very badly damaged by rust ; in fact, the crop throughout Western Ontario is almost totally destroyed. Much of it is not worth threshing and farmers in many localities are cutting it for fodder. In the Eastern part of the Province, the great spring wheat region, the reports are more encouraging and there is reasonable hope that the grain will thresh out a fair average. The barley crop was badly damaged by the storm of August 3rd, and much of what was left is injured by bad weather in harvesting. The total product is put at 693,000 bushels. Oats, rye and peas, are estimated at averages of 36.5, 16.0, and 22.2 bushels per acre respectively.

The question to be decided by the race between the English yacht "Genesta" and the American yacht "Puritan," is, according to some humorist, whether a plank can be propelled faster through water on edge, or on the flat. The "Puritan" is comparatively broad of beam, and requires only some twenty or thirty tons of lead ballast to enable her to stand up under her immense load of mast and canvas. Instead of a keel proper she has a centre board which can be raised or lowered at pleasure. The "Genesta" is sharp and deep, and has her equilibrium preserved by about seventy tons of lead in her keel. The question has raised a great deal of feeling, not the best-natured, but the handsome conduct of the owner of the "Genesta" in refusing to accept the race as a "walk over," when the judges unanimously gave him the option, in consequence of the foul caused by the "Puritan's" violation of rules and consequent collision, have done much to restore a better humour.

BUSINESS ANNOUNCEMENT.

We have to announce to our subscribers and all others interested that a change has been made in the management of the CANADA SCHOOL JOURNAL. Mr. J. M. Kennedy who has been business manager since the JOURNAL began to be issued as a weekly retires to accept another position, and Mr. J. L. Robertson, having purchased a large interest, assumes from this date the entire charge of the business department. It is unnecessary for us to say a word in reference to either of these gentlemen, as both are well and favorably known to most of the patrons of the JOURNAL. Mr. Robertson does not take hold of the work as a novice, as the JOURNAL prospered under his hand for several years when it was being published as a monthly. Mr. Kennedy was unable to give his time exclusively to the work in consequence of various other engagements, but Mr. Robertson, we are glad to say, will devote all necessary time and attention to the management of the JOURNAL. He is determined to make it a still greater success in the future than it has been in the past, and those who know his thorough business habits will know that he is the right man in the right place. All business communications addressed to him at the EDUCATIONAL EMPORIUM and office of the CANADA SCHOOL JOURNAL, 423 Yonge St., Toronto, will receive prompt attention.

The School.

Question Drawer next week.

In response to requests of teachers we commence in this issue the publication of the last Entrance Examination Papers. These will be continued in future numbers.

Apropos to the incident of the clerical advice referred to in another paragraph, it seems to us too high ground cannot be taken by the teacher in church or school against the vice of lying. Truth is one of the eternal laws of the universe. It is based on the very foundation of our nature. It underlies the whole superstructure of confidence between man and man. A community of liars would be a pandemonium. Law, order, business, social intercourse, everything that makes life worth living would be undermined and tottering. Once admit with the clergyman in question, that lying may be justified under certain circumstances, and you make honor a myth, and morality a dream. Truth is dragged down from heaven and trampled in the mire of human expediency. It is but a matter of profit and loss, a thing of barter. If this, that and the other gain in money or personal safety, warrants the lie, who shall draw the line, and where? Let Canadians ever and everywhere be taught that "nothing needs a lie."

The clergy take it upon themselves to exhort teachers to have a care in cultivating such moral qualities as honesty, honor and truthfulness in their pupils. This is all right and proper, and most teachers will gladly "suffer the word of exhortation." But alas, for poor humanity! Happily there are not many clergymen like the English Liberal one who lately addressed a circular to his parishioners in regard to their political duties, in which he distinctly advised the poor electors, enfranchised under the new act, if they had reason to fear loss of employment as a result of voting according to their convictions, to lie deliberately to their employers, rather than vote against their consciences. It is no wonder that the Bishop of Carlyle felt called upon to denounce such monstrous teaching, but it is ominous that a leading Canadian journal should be found half-condoning, half-apologizing for so grave a violation of the simpler code of manly, not to say Christian honor. One of the benefits looked for by thoughtful men from the extension of the ballot is believed to inhere in its educational power. It would be sad indeed if its first educational influence should be in the shape of a direct training in the meanness and cowardice of lying.

Normal School and other students will learn, we are sure, with much satisfaction that the "Elementary Chemistry," in this and subsequent numbers, is being specially revised for the JOURNAL by Dr. Kirkland, Principal of the Normal School. These lessons were originally prepared by Dr. Kirkland for *The School Examiner*, and arrangements have now been made to have them revised by the author, so that they will conform in every respect to the present requirements of the Normal School course.

We have received of late from subscribers an unusually large number of complaints of non-delivery of THE JOURNAL. These are explained in part by the fact that the paper was issued only on alternate weeks during the holidays (July and August). Our arrangements in this respect were fully announced in the JOURNAL, but the announcement seems to have escaped the notice of a number of subscribers. Apart from this, however, there seems to have been altogether too much irregularity in the delivery of the paper—an irregularity for which we are unable to account. We regret the fact and are chagrined and annoyed by it. We hope to be able to supply missing numbers in most cases, and the attention of the new business manager having been specially called to the matter he will spare no pains to insure careful and punctual mailing. He will be glad if every subscriber, who fails to receive his JOURNAL duly, will notify him without delay.

We hear it rumored that the Minister of Education is about to authorize the preparation of a Sixth Reader for use in the Schools. It is to be hoped that this is not the case. In the opinion of many of the best educators we have too many scrap readers already, and it would greatly promote both good reading, and the taste for good literature, if select, complete works of the best authors were substituted for at least the fourth and fifth readers already used. To carry the process of the manufacture and use of these books further would be to fly in the face of the opinions of those most competent to judge and to choose retrogression rather than intelligent progress.

The latest educational report for Great Britain and Ireland shows that about 30 per cent. of the teachers are now furnished with residences free of rent. Next to a handsome increase of salaries we know of nothing that would be more effective in improving the status of teachers and securing and retaining good men in the profession in Ontario, than to provide comfortable residences in connection with the schools, especially in country districts where it is often very difficult to find suitable houses for rent. This circumstance alone has, no doubt, much to do with driving married men, and those wishing to marry, out of the profession.

Several parties have of late written to the *Mail* complaining of the exorbitant price charged for the new drawing books. It is said, and so far as we have observed, is uncontradicted, that these books for which 10 cents is charged, could be produced for 3 cents, with a profit. If this is so the arrangement is a monstrous imposition upon the public, out of which the publishing company must make a large fortune in a very short time. According to the computation, which is certainly a moderate one, at least 400,000 of the books will be required per year in the schools. This makes a net gain of $28,000 per year to be divided between the publishers and the retail dealers. As the latter receive only a fixed percentage on the selling price, the publishers of these books, like those of the readers, must have a decidedly "good thing." The same process will be repeated, we suppose, with new geographies, grammars, &c., as fast as these are authorized. The fact is the

whole system which permits the Education Department to have relations with the publishers, and to make fortunes for them, as it evidently can, at pleasure, is one of the worst conceivable. The wonder is that the intelligent people of Ontario can sanction it.

EDUCATION AND CRIME.

"Knowledge comes, but wisdom lingers." The laureate's aphorism is as true of the race as of the individual. The whole history of prisons on the one hand and public schools on the other proves it. The day is near when all intelligent people will look back with amazement, not unmixed with horror, on the manner in which the most enlightened nations, even in the latter half of the nineteenth century, dealt with their street waifs and juvenile criminals. To suffer thousands of orphaned, or worse than orphaned, children in every great city to grow up in sinks of material and moral filth, in training for lives of vice and crime, is a folly surpassed in depth and culpability only by the infatuation which hands over the youth convicted of his first offence to be branded with the infamy of a jail-bird, and made the constant associate of the most confirmed criminals. Is it any wonder that the prisons are crowded with inmates and the streets dotted with detectives? Is it any wonder that people everywhere are crying out that free schools and universal (?) education are failures, so far as their promised results in annihilating crime are concerned?

We know of no two agencies which to-day contain the promise and potency of so much good to society as the Industrial and Reformatory Schools which are springing into existence. They are but in their infancy as yet, but already they are accomplishing wonders. According to a recent report of the Inspector of these schools in Great Britain there were in 1884 no less than 6,360 youths in the reformatory schools, and 19,483 in the industrial schools. This means a total of nearly 26,000 boys and girls of the most destitute and dangerous classes being trained systematically for lives of honest industry and usefulness.

But what of the results of this training? To what extent is it successful in eradicating the taint of evil too often born in the blood, or vagrant and vicious habits too often bred in the bone? It would be idle, of course, to expect either that the best modes of treatment should be formed at once and applied, or that even the wisest treatment should be in all cases successful. Those who set out to be moral benefactors must lay their account for a plenteous crop of disappointments.

Nevertheless, the results as reported are encouraging even beyond the expectations of any but the most sanguine. Statistics show, for instance, that no less than 80 per cent. of those who are sent out from the reformatory at Elmira, N.Y., are permanently reformed, and go forth to lives of honorable industry. The facts presented in the British Inspector's report correspond with these in a wonderful manner. In regard to the reformatory schools, we are told that of the 4,904 boys discharged during the three years from 1881 to 1883 inclusive, "79 per cent. were doing well; 2 per cent. were doubtful; 14 per cent. were convicted, and about 5 per cent. were unknown. Of the girls, 72 per cent. were doing well; 9 per cent. were doubtful; 6 per cent. were convicted, and 13 per cent. were unknown."

"In the industrial schools the exhibit was still more satisfactory. In the three years ending with 1883 the dismissions were 9,569. Of the boys thus discharged 81 per cent. were doing well, 3 per cent. were doubtful, and about 5 per cent. were committed. Of the girls 81 per cent. were doing well, 7 per cent. were doubtful, and only 2 per cent. had been convicted."

Who can fail to see in these facts a new hope for humanity? Surely these philanthropic men and women amongst us who are working for the establishment of such institutions are deserving of every encouragement and aid. The British inspector says there is no better work for the purpose of industrial training than farming. Suppose that every boy and girl in our Canadian cities who is without home, employment, or guardianship could be given a few years' training in such a school and then transplanted to the wholesome atmosphere of the farm or mechanic's shop, can anyone doubt that a wonderful depopulation of our jails and penitentiaries would shortly follow?

Our space forbids us to pursue the subject, else we believe it could easily be shown that there is not an argument from the principles of political economy which can be urged in favor of the expenditure of public money in the support of schools and colleges which does not apply with increased force to such institutions as these. We do not know to what extent those who are engaged in the work find their efforts hampered or frustrated by the extreme to which the doctrine of parental rights is carried in modern legislation. There is, no doubt, need for considerable modification of the laws in this respect. Parental rights should be sacred only so far as parental duties are discharged. The drunken and dissolute should not have it in their power to entail misery upon their posterity and injury upon the State by training their offspring to follow in their own footsteps.

Special.

ELEMENTARY CHEMISTRY.

CHAPTER II.

SECTION I.

OXYGEN.

Symbol, O. Atomic Weight, 16 (15.96.) Molecular Weight, O_2 32.

PREPARATION.

34. From Mercuric Oxide. This method possesses special interest, since it is that by which oxygen was first prepared by its discoverer, Priestly. When mercury is heated in contact with air to a temperature of about 450°C, it gradually becomes covered with red scales of Mercuric Oxide, HgO, and when these red scales are exposed to a temperature of about 630°C. they begin to be decomposed into oxygen and metallic mercury. Atoms, when liberated form molecules, and in order to satisfy Avogadro's Law, the molecule of mercury must consist of a single atom, and the molecule of oxygen of two atoms, and since a single molecule of mercuric oxide does not yield an even number of atoms, we take two molecules and represent the reaction by the following equation:—

$$\underset{\text{Mercuric Oxide.}}{2HgO} = \underset{\text{Mercury.}}{2Hg} + \underset{\text{Oxygen.}}{O_2}$$

35. Dissociation.—Decomposition like that of mercuric oxide under the influence of heat is an example of what is known as *dissociation*. This term is applied to those cases of decomposition in which certain bodies are resolved at an elevated temperature into simpler bodies, which are capable of re-uniting and reproducing the original compound when the temperature is again allowed to fall.

36. From Potassium Chlorate.

Exp. 1.—A molecule of the white crystalline substance called Potassium Chlorate consists of one atom of Potassium, the symbol of which is K, one atom of Chlorine, Cl, and three atoms of Oxygen, O_3; hence its formula is denoted by $KClO_3$. Take a few crystals of this substance, put them into a test-tube, and heat, gently at first, loosely stopping the mouth of the test-tube with the thumb. The salt begins to spirt or "decripitate," then fuses, and on further heating appears to boil Plunge a glowing splint of wood into the tube; the splint immediately bursts into flame with a slight explosion, showing that oxygen gas has been produced. Now, if oxygen has been produced from potassium chlorate, that substance must have undergone a change. To put this to the test, take a few crystals of the chlorate, dissolve them in water in a test-tube, and add a drop or two of a solution of silver nitrate; the liquid remains clear. Dissolve a small quantity of the substance remaining in the test-tube, and add a drop or two of silver nitrate solution; at once a white solid forms in the liquid, showing that the potassium chlorate has been changed by heat. The substance remaining in the test tube when the oxygen is given off is called Potassium Chloride, KCl. The reaction which has taken place is expressed by the following equation:—

$$\underset{\text{Potassium chlorate}}{2KClO_3} = \underset{\text{Potassium chloride}}{2KCl} + \underset{\text{Oxygen}}{3O_2}.$$

37. From Potassium Chlorate and Manganese Dioxide.

To obtain oxygen from potassium chlorate, greater heat is required than glass vessels generally bear, and it is, therefore seldom adopted in practice, except when very pure oxygen is required. It is found, however, that if the potassium chlorate is mixed with about one-fourth its weight of manganese dioxide, MnO_2, the oxygen is given off at a much lower temperature.

Exp. 2.—Coarsely powder 20 grams (nearly ¾ oz.) of potassium chlorate, place it upon a piece of paper, turned up at the edges so as to form a kind of trough, and by means of this transfer the chlorate to a test-tube 6in. by ¾in. This quantity will about half fill the tube. Place upon the same paper about 5 grams of manganese dioxide and transfer it to the test-tube. Place a small piece of paper on the mouth of the tube to keep the thumb clean, and shake vigorously till the two substances are thoroughly mixed. Choose a sound cork, very slightly larger than the mouth of the test-tube, squeeze it well till it becomes soft and elastic, and with a cork borer or rat-tail file bore a hole through it so that a glass tube may be inserted tightly into it. Take a piece of glass tubing about 45 centimeters (18 inches) in length, bend it in two places, one downwards about 5 centimeters (2 inches) from the end of the tube; the other should be upwards and as near the other end of the tube as possible. The object of the second bend is to facilitate the escape of the bubbles of gas by giving them a forward and upward direction. The downward bend should now with gentle pressure and twisting motion be inserted in the cork.

Take a large cork, bore a hole in it to fit the rod of the retort-stand, twist a piece of copper wire around the cork, leaving about eight inches of the end free. Twist the free ends of the wire around the test-tube, insert the cork in the tube and arrange for collecting the gas.

Take two quart and five pint bottles, fill two of them with water, and place mouth downwards, one on the shelf of the pneumatic trough, the other in the water in the trough, ready to take the place of the one on the shelf. On gently heating the test-tube, oxygen will readily be given off. When the bottle is full, slide it off the shelf with one hand, and with the other slide the full bottle into its place. Bring a glass plate under its mouth while still under water, raise it out of the water, and place it mouth upwards on the table. If any of the bottles have to be kept for a considerable time, they shou'd be placed mouth downwards in a saucer containing a little water, which will act as a valve to prevent the gas from escaping.

One ounce or 28.3 grains of potassium chlorate should yield 1¾ gallons, or nearly 7.75 litres.

38. Precautions.—In performing this experiment, the following precautions should be observed:—

(1) In the preparation of the mixture, care must be taken to avoid the accidental introduction of small fragments of organic matter. A small quantity of the oxygen mixture should be heated in a test-tube before using it on a large scale, as occasionally the manganese dioxide contains lamp-black and substances of kindred nature, the presence of which would lead to an explosion.

(2) When the delivery-tube is fitted into the cork, and the cork into the test-tube, blow down the open end of the delivery-tube; no air must be heard to escape, or must be seen to bubble out on moistening the cork.

(3) As soon as the oxygen begins to be delivered, the heat beneath the test-tube should be so regulated that the evolution of the gas should be tranquil and uniform.

(4) The uppermost portions of the mixture should be heated before the lower, which should be heated only after the uppermost parts refuse to yield any more gas.

(5) The test-tube should never be more than three-fourths full, lest particles of solid matter be projected into the delivery-tube.

(7) The test-tube should be inclined at an angle of about 45°, and must never be placed upright.

(7) When the process is to be stopped, the end of the delivery-tube must be immediately removed from the water, otherwise the cold-water is liable to go back into the hot test-tube and break it; and the test-tube must not be allowed to touch cold or wet objects, which would cause the hot glass to crack.

39. Manner in which the Manganese Dioxide acts.

Exp. 3.—Mix one gram of potassium chlorate with half a gram of each of the following substances, viz.: Manganese

dioxide, MnO_2, copper oxide, CuO, ferric oxide, Fe_2O_3, lead oxide, PbO, zinc oxide, ZnO, magnesium oxide, MgO, sand, and powdered glass. Put these several mixtures into as many test-tubes, and into another test-tube put one gram of potassium chlorate alone. Imbed the tubes side by side in sand to about the same depth as they are filled within, apply a gradually increasing heat, and by means of glowing splints frequently plunged into the different tubes, observe the difference in the readiness with which the oxygen is evolved from the several mixtures. It will be seen that there is little difference among the first four tubes, and that the heat will probably not be sufficient to cause the oxygen to be evolved from the other five. After all the oxygen has been given off, about half-fill the first tube with water and gently heat till its contents are dissolved, filter through a piece of blotting paper, and gently dry on the hot sand the black substance remaining on the filter. It will be found to be manganese dioxide, and that it is in the same state after the experiment as at the commencement. The same is true of the next three oxides. These oxides may, however, undergo a temporary change. We know that MnO_2 is capable of taking up more oxygen and, combining with a molecule of water to form manganic acid, H_2MnO_4, and it is possible that when heated with potassium chlorate the manganese dioxide may absorb oxygen from this substance, and pass to the state of the higher oxide which is immediately decomposed, the oxygen being evolved and the manganese dioxide returning to its original state. The same applies to the next three oxides, all of which are known to be susceptible of higher oxidation. The zinc oxide and magnesium oxide, on the other hand, which do not form higher oxides, do not facilitate the decomposition of the chlorate.

40. Physical Properties of Oxygen.

Exp. 4.—Take the first bottle filled, which will contain a little air, but will suit well enough for this experiment. Observe the physical properties of the gas; it has neither color, taste, nor smell. Plunge a glowing splint of wood into it; the splint bursts into flame as in the preceding experiment. Hold the glowing splint at different heights *above* the mouth of the bottle; it will not burst into flame. Leave the bottle for a short time standing on the table with its mouth open; the glowing splint will show that the gas has not escaped. Turn the bottle mouth downwards, and hold the glowing splint *near* its mouth; it will burst into flame. Hold the bottle in this position for a short time; the splint will no longer burst into flame when plunged into the bottle. The gas has escaped. *Oxygen is, therefore, heavier than air.*

41. Combustion of Phosphorus in Oxygen.

Exp. 5.—Take a quart bottle of oxygen, and adjust the deflagrating spoon by holding it against the outside of the bottle, so that the little metallic cup may be about 5 centimetres (2 inches) from the bottom of the bottle, and put a little lime into it to absorb the moisture. Take a piece of phosphorus not larger than a small pea, dry it carefully with soft blotting paper, and place it on the lime in the cup. The phoshorus must not be touched with the fingers after it is dry, and it should be dried only when about to be used. Place the spoon in the bottle and touch the phosphorus with the end of a heated glass rod. The phosphorus burns brilliantly, and when the heat volatilizes it a flash of light fills the whole vessel, owing to the points of contact between the phosphorus and the oxygen being indefinitely increased, and the bottle is filled with dense white fumes. The phosphorus has combined with the oxygen, forming the white, snow-like substance called *Phosphorus Pentoxide*, P_2O_5. The molecule of phosphorus consists of *four* atoms, and the reaction is expressed as follows:—

$$\underset{\text{Phosphorus.}}{P_4} + \underset{\text{Oxygen.}}{5O_2} = \underset{\text{Phosphorus pentoxide.}}{2P_2O_5}$$

42. Acids.

Phosphoric Acid.—Pour a little water into the bottle and shake it up; the phosphorus pentoxide dissolves in the water. Taste a few drops of the solution; it is exceedingly sour. Pour into it some blue litmus solution; it will be immediately reddened. A substance possessing these characteristics is called an *acid*. The phosphorus pentoxide has combined with a molecule of water thus:—

$$\underset{\text{Phosphorus pentoxide.}}{P_2O_5} + \underset{\text{Water.}}{H_2O} = \underset{\text{Metaphosphoric acid.}}{2HPO_3}$$

43. Combustion of Sulphur in Oxygen.

Exp. 6.—Wash the lime out of the cup of the deflagrating spoon, and dry it by holding it in the flame of the spirit-lamp. Place in it a piece of sulphur about as large as a pea. Heat the spoon in the flame until the sulphur melts and begins to burn with a pale-blue almost invisible flame, then place the spoon in a bottle of oxygen; the sulphur burns with a much brighter flame, emitting a beautiful violet-colored light. When the combustion is over, remove the spoon and observe, (1) the pungent suffocating smell of the gaseous combination of sulphur and oxygen which has been produced; (2) the seeming absence of anything in the bottle, the product of combustion being an invisible gas; (3) that a lighted paper plunged into the bottle will be immediately extinguished. The gas is called *Sulphur Dioxide*, SO_2, and the reaction is as follows:—

$$\underset{\text{Sulphur.}}{S_2} + \underset{\text{Oxygen.}}{2O_2} = \underset{\text{Sulphur dioxide.}}{2SO_2}$$

44. Sulphurous Acid.

Pour a little water into the bottle and shake it up. Observe that the hand is drawn into the bottle, showing that a vacuum has been produced Taste a few drops of the water; it is sour. Pour a little of it into litmus solution in a test-tube; the solution is immediately reddened. This reddening of the vegetable blue coloring-matter is called the "*acid reaction.*" The gas has combined with a molecule of water to form *Sulphurous Acid*, H_2SO_3, thus:—

$$\underset{\text{Sulphur dioxide.}}{SO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sulphurous acid.}}{H_2SO_3}$$

45. Combustion of Carbon in Oxygen.

Exp. 7.—Cleanse the deflagrating spoon from sulphur, by holding it in the flame of the spirit-lamp till no smell of sulphur is perceived. Select a few splints of wood charcoal; place them upon the deflagrating spoon, and adjust it in a bottle of oxygen, as in the first experiment. The charcoal burns energetically in the gas, emitting much light and heat but little or no flame; observe that the product of combustion is an inodorous, invisible gas. Plunge a lighted taper into the bottle; the taper is extin-

guished. The charcoal (carbon) combines with the oxygen forming *Carbon Dioxide*, CO_2, thus:—

$$\underset{\text{Carbon.}}{C^*} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Carbon dioxide.}}{CO_2}$$

46. Carbonic Acid. Pour about half a tumblerful of water into the bottle and shake it vigorously. The hand will be drawn in, but not as forcibly as in Exp. 6; carbon dioxide is only moderately soluble in water. Pour some of the water into a glass and taste it; it is slightly sour. Pour some of it into litmus solution; the solution is turned a dark-red color. The carbon dioxide has combined with the water, forming *Carbonic Acid*, H_2CO_3, thus:—

$$\underset{\text{Carbon dioxide.}}{CO_2} + \underset{\text{Water.}}{H_2O} = \underset{\text{Carbonic acid.}}{H_2CO_3}$$

47. Meaning of Test. Pour some clear lime-water *into the carbonic acid reserved from the last experiment*; the clear liquid becomes milky, indicating the presence of carbonic acid, as will be hereafter explained. Lime-water is said to be a "test" for carbon dioxide or carbonic acid. *A test is a material for some experiment intended to bring out a property characteristic of the substance under examination, and by which the presence of that body may be detected.*

48. Origin of name Oxygen.—In the preceding experiments the products of combustion in oxygen when combined with water formed acids. The name OXYGEN (from the Greek *oxus*, sour, and *gennao*, I produce), was given by Lavoisier, under the mistaken impression that this element contained a principle common to all acids. This is now known to be an error. Later researches have brought to light a number of compounds containing hydrogen possessed of acid properties in which no oxygen is present. Nevertheless the name was not ill-chosen, for of the many hundreds of acids known there are only about six which do not contain oxygen,

49. Combustion of Sodium in Oxygen.

Exp. 8.—*Take a small piece of metallic sodium, scrape it* clean with a knife, heat it in the deflagrating spoon till it melts and begins to burn, then plunge it into a bottle of oxygen; it will burn with great brilliancy and with a bright yellow flame. A white solid called *Sodium Oxide*, Na_2O, is formed. The reaction is—

$$\underset{\text{Sodium.}}{2Na_2} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Sodium oxide.}}{2Na_2O}$$

50. Alkalies—Sodium Hydrate.—Add a little water to the bottle, shake it up and taste a few drops of the solution: it does not taste sour, but has a peculiar nauseous taste, and is soapy to the touch. Add a little to blue litmus solution; it is not reddened, but on the contrary becomes rather darker in color. Dip a glass rod into hydrochloric acid, and with it redden some blue litmus solution. Pour into this some of the solution of the sodium oxide; the red solution at once becomes blue. *The solution of sodium oxide acts upon vegetable colors in just the opposite way from acids, and will, in fact, neutralize their action.* It is called an *alkali*, and substances like this which will restore the blue color of reddened litmus are said to have an *"alkaline reaction."* The sodium oxide has combined with a molecule of water, forming a substance called *Sodium Hydroxide* or *Sodium Hydrate*, NaOH, better known by its common name of *Caustic Soda*, thus

$$\underset{\text{Sodium oxide.}}{Na_2O} + \underset{\text{Water.}}{H_2O} = \underset{\text{Sodium hydrate.}}{2NaOH}$$

Similarly, if we burn the metal potassium in oxygen, we obtain *Potassium Oxide*, K_2O, which combines with water, to form *Potassium Hydrate*, KOH.

51. Combustion of Magnesium in Oxygen.

Exp. 9.—Burn 10 or 12 centimetres (4 or 5 inches) of Magnesium ribbon in oxygen. A white solid called *Magnesium Oxide*, MgO, is formed; thus:—

$$\underset{\text{Magnesium.}}{2Mg} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Magnesium oxide}}{2MgO}$$

52. Bases—Magnesium Hydrate. Pour a small quantity of water into the bottle containing the magnesium oxide and shake it vigorously; it does not seem to dissolve in the water. Add some of it to blue and reddened litmus solutions; it has apparently neither *acid* nor *alkaline* reactions. Dip a piece of white blotting paper in reddened litmus solution, put it into the liquid and leave it for some time; it becomes blue. Half fill a test-tube with water and add to it *one* drop of nitric acid; the solution will readily redden blue litmus paper when dipped into it. Pour the solution into the bottle in which the magnesium was burnt and shake it vigorously; it will no longer redden either blue litmus paper or blue litmus solution. The acid has been *neutralized*. *A body possessing the characteristic of neutralizing an acid, either partly or entirely, is called a* BASE. An *alkali* is only a base, which is freely soluble in water. Acids and bases will be fully discussed in a future chapter. It may be stated here that the characters of taste and reaction belong to all well-marked acids and bases which are soluble in water; but they do not belong to *all* the acids and bases. In this case a molecule of water has combined with the magnesium oxide to form Magnesium Hydrate, $Mg(OH)_2$; thus:—

$$\underset{\text{Magnesium oxide.}}{MgO} + \underset{\text{Water.}}{H_2O} = \underset{\text{Magnesium hydrate.}}{Mg(OH)_2}$$

53. Combustion of Iron or Steel in Oxygen.

Exp. 10.—Take a piece of thin watch-spring, which may be obtained from any watchmaker, heat it in the flame of a spirit-lamp till it is red-hot, and allow it to cool; it will then have lost its elasticity. Coil it into a spiral around a glass tube, clean one end with a file, twist it round a bit of charcoal, and fasten the other end to the cap of the deflagrating spoon, and plunge in into a quart bottle of oxygen, on the bottom of which there is at least an inch of water. The burning cork heats the steel to redness, which then combines with the oxygen burning brilliantly, forming *Magnetic* or *Black Oxide* of Iron, Fe_3O_4, and throwing out abundance of sparks. The sparks are red-hot carbon contained in the steel, which also combine with the oxygen, forming carbon dioxide. The oxidized iron falls to the bottom in black globules, which are so hot that they are apt to melt into the glass and crack it, unless they have to pass through a considerable depth of water. The reaction is:—

$$\underset{\text{Iron.}}{3Fe} + \underset{\text{Oxygen.}}{2O_2} = \underset{\text{Magnetic oxide of iron.}}{Fe_3O_4}$$

* The number of atoms in a molecule of carbon is unknown, and in such cases the symbol for the atom is used in equations.

54. Magnetic Oxide.—Pick out the black globules and examine them as in the preceding experiments. They do not produce an acid with water under any conditions, nor do they exhibit any alkaline or basic characters, and may therefore be classified as *indifferent* or neutral oxides.

55. Ferric Oxide.—Observe that the inside of the bottle becomes covered during the experiment with brick-red oxide, Fe_2O_3, which is called *Ferric Oxide.* This ferric oxide is insoluble in water, and, therefore, cannot be tested with litmus. It will, however, neutralize acids, and is, therefore, a base.

56. Oxides.—These experiments show that there are three kinds of oxides :—

I. *Acid producing oxides or Anhydrides.*—These oxides combine with water to form *acids*, or substances usually possessing *a sour taste, which turn blue litmus red, and which neutralize* basic oxides, forming a class of compounds termed *Salts.* All the non-metallic elements, with the exception of hydrogen and florine, form one or more compounds with oxygen, which when united with water, yield acids, and in many cases intensely powerful acids. The following are of this class :—

Phosphorus pentoxide,	P_2O_5	yields with water	Metaphosphoric acid,	HPO_3.
Sulphur dioxide,	SO_2	"	Sulphurous "	H_2SO_3.
Carbon . "	CO_2	"	Carbonic "	H_2CO_3.

II. *Indifferent Oxides.*—These oxides are indisposed to enter into combination with either acids or bases. They usually contain more oxygen than the basic oxides, a portion of it being loosely combined, and given off on heating. The following belong to this class :—

Manganese dioxide, MnO_2.
Black oxide of iron, Fe_3O_4.
Lead dioxide, PbO_2.

III. *Basic Oxides.*—*Many of the metals, by their union with* oxygen, give rise to oxides the characteristic property of which is their power of neutralizing acids, thereby forming salts. Many of them combine with water to form a class of compounds called *Hydroxides* or *Hydrates.* The following are of this class :—

Sodium oxide,	Na_2O,	yields with water,	Sodium hydrate,	$NaOH$.
Magnesium oxide,	MgO,	" "	Magnesium hydrate,	$Mg(OH)_2$.
Ferric oxide.	Fe_2O_3	" "	Ferric hydrate,	$Fe_2(OH)_6$.

57. Other Methods of Preparing Oxygen.

From Manganese Dioxide.—By heating the manganese dioxide to redness in a piece of gas-pipe or gun-barrel, it gives off the one-third of its oxygen ; thus :—

$$\underset{\text{Manganese dioxide.}}{3MnO_2} = \underset{\text{Red oxide of manganese.}}{Mn_3O_4} + \underset{\text{Oxygen.}}{O_2}.$$

From Manganese Dioxide and Sulphuric Acid.—By gently heating manganese dioxide and sulphuric acid when manganese sulphate and water are formed, and half the oxide which the dioxide contained is disengaged ; thus :—

$$\underset{\text{Manganese dioxide.}}{MnO_2} + \underset{\text{Sulphuric acid.}}{H_2SO_4} = \underset{\text{Manganese sulphate.}}{MnSO_4} + \underset{\text{Water.}}{H_2O} + \underset{\text{Oxygen.}}{O_2}.$$

By decomposing Water by Electrolysis.—This has already been effected.

58. Tests for Oxygen.

(1). **Exp. 11.**—Fill a test-tube with oxygen, pour into it a small quantity of a strong solution of caustic potash, and add an equal quantity of a strong solution of pyrogallic acid. Cut a piece about the size of a cent from an old rubber over-shoe, place it on the mouth of the tube to protect the thumb, and shake vigorously ; *the solution in the tube becomes intensely brown.* This test will indicate the presence of very small quantities of oxygen. Invert the tube in water and withdraw the thumb ; the water will rush into the tube and entirely fill it, showing that the solution has absorbed the oxygen.

(2). **Exp. 12.**—Put a few bits of clippings of sheet-copper into a test-tube. Add a small quantity of dilute nitric acid ; an effervescence begins, and the tube is filled with red vapors. These soon disappear, and a colorless gas comes over. Allow this to escape, and then pass the gas into a bottle of oxygen standing mouth downwards on the shelf of the pneumatic trough ; immediately red vapors are formed which the water soon absorbs. The colorless gas is nitric oxide, NO, which unites with the oxygen forming higher nitrogen oxides ; thus :—

$$\underset{\text{Nitric oxide.}}{2NO} + \underset{\text{Oxygen.}}{O_2} = \underset{\text{Nitrogen peroxide.}}{2NO_2}$$

SUMMARY AND ADDITIONAL FACTS.

59. History.—Oxygen was discovered by Priestly in 1774, who, heating mercuric oxide with a burning glass, decomposed the oxide into oxygen and metallic mercury. Scheele, a Swedish apothecary, obtained it independently a year later. It was liquified by Pictet, of Geneva, in December, 1877, under a pressure of 300 atmospheres and the temperature produced by the evaporation of liquid carbon dioxide in a vacuum.

60. Occurrence.—It is the most abundant and most important of all the elements. About one-fifth of the atmosphere consists of free oxygen ; no less than eight *ninths of water* is formed of the same gas. It makes up three-fourths of our own bodies, not less than four-fifths of every plant, and about one-half of the solid rock. Indeed, it seems to be the preponderating element of the globe.

61. Properties.—Oxygen is a colorless, odorless, and tasteless gas. It is a little heavier than air, its specific gravity being 1·1056, air being taken as unity, and 16 when hydrogen is taken as the unit. It is only slightly soluble in water, 100 volumes of which at ordinary atmospheric temperature dissolve about three volumes of water. On the solution of this small quantity of water depends the existence of fishes and other forms of animal life in the waters of rivers, lakes, and seas. Fishes pass water continually through their gills, in which the oxygenation of their blood takes place.

Oxygen is a great supporter of animal life. Pure oxygen, however, differs from dilute oxygen in its effects on life. A small animal placed in a vessel of oxygen soon dies of excessive excitement produced by a too rapid oxidation of its blood. It is equally necessary to vegetable life, being needful to the development of the buds of maturer plants, and also being absorbed by their roots. Hence, if much earth is piled about a healthy tree, the tree soon sickens ; while, on the contrary, if its roots find their way into a drain, the tree grows better than ever.

In all cases in which bodies burn in oxygen, the substance burnt combines with oxygen to form new substances, and the heat and light developed are a consequence of this union. The weight of the product corresponds exactly with the weight of the body burned, *plus* the weight of the oxygen consumed. *The combination of two or more bodies, when accompanied by the development of heat and light is termed* COMBUSTION, the body burnt being the *combustible*, and the body in which the burning takes place the *supporter* of combustion. These are, however, merely relative terms, as will be shown when combustion is discussed.

The combination of oxygen with other elements is termed oxidation. In all cases of oxidation heat is developed, but it depends on the rapidity with which the oxidation is effected whether light is also produced. Thus, when iron is burnt in oxygen, the combination of the two elements is effected with great rapidity, a large amount of heat is developed within a short space of time, and the product of combustion becomes incandescent. When, however, iron oxidizes or rusts slowly, no light is produced, although more heat is developed than when the same weight of iron is burnt in oxygen, the oxide, Fe_3O_4, being formed in the latter, and the oxide, Fe_2O_3, in the former case.

Oxygen combines with all the non metallic elements, except fluorine. All metals combine with oxygen. When metals are easily soluble, as is the case with magnesium and zinc, they burn with a bright flame in oxygen. A few metals such as gold and platinum, cannot be made to unite directly with oxygen, even at the highest temperatures. The oxides of such metals can, however, be prepared by indirect means.

Oxygen readily combines with oils, woollen refuse, greasy tow, moist hay, &c., the heat developed by their slow oxidation being to a great extent retained, as they are bad conductors of heat, until finally it is sufficient to inflame them. This is termed *Spontaneous Combustion*, and it is one of the most common sources of fire, both in manufactories and on board ship, and in hay-ricks in which the hay has been put up damp, for moisture greatly assists the process of slow combustion.

By oxidation earth, air, and sea, are purified from contamination; noxious vapors and pestilential effluvia being destroyed by a process of burning, more slow indeed, but as real as takes place in a furnace. The offensive impurities which flow into rivers and lakes are oxidized by the dissolved gas, and thus the waters are kept pure.

62. Tests.

(1) A glowing splint of wood bursts into flame when plunged into oxygen, and the purity of the gas may be roughly estimated by the degree of sharpness with which the wood bursts into flame.

(2) Pure oxygen turns a solution of pyrogallic acid in strong potash brownish-black, and is completely absorbed by it.

(3) With nitric oxide, oxygen gives red fumes of nitric oxide.

Examination Papers.

HIGH SCHOOL ENTRANCE, JULY, 1885.

ENGLISH LITERATURE.

Examiner—JOHN SEATH, B.A.

NOTE.—100 marks constitute a *full paper*. A *maximum* of 15 marks may also be allowed for composition, and of 5 marks for writing and neatness.

CANADIAN READERS.

1. Lives of great men all remind us,
We can make our lives sublime,
And, departing, leave behind us
Footprints on the sands of time;

Footprints that, perhaps, another,
Sailing o'er life's stormy main,
A forlorn and shipwrecked brother,
Seeing, shall take heart again.

Let us, then, be up and doing,
With a heart for any fate;
Still achieving, still pursuing,
Learn to labor and to wait.

(*a*) Why is the poem to which these stanzas belong called "A Psalm of Life"?

(*b*) Explain "sublime," and illustrate by an example the meaning of ll. 1-2.

(*c*) As what are "time" and "life" here represented? Explain the use of "solemn."

(*d*) What is really meant by "*a forlorn and shipwrecked brother*," and "take heart again"?

(*e*) How could the "footprints" produce this effect?

(*f*) Express by a clause the meaning of "then."

(*g*) Show by the preceding part of the poem what is meant by "*up and doing*" and "*With a heart for any fate.*"

(*h*) Distinguish "achieving" and "finishing." Why is "still" repeated?

(*i*) Give in your own words the meaning of ll. 11 and 12.

(*j*) Name the emphatic words in ll. 1-6, and show where the pauses should be made in ll. 1-4. What feelings should we express in reading ll. 9-12?

(*k*) What lessons, for our guidance in life, may we learn from "A Psalm of Life"?

2. The Town Pump and the Cow! Such is the glorious partnership that *shall finally monopolize the whole business of quenching* thirst. Blessed consummation! Then Poverty shall pass away from the land, finding no hovel so wretched where her squalid form may shelter itself. Then Disease, for lack of other victims, shall gnaw his own heart and die. Then Sin, if she do not die, shall lose half her strength. *Then there will be no war of households.* The husband and the wife, drinking deep of peaceful joy, a calm bliss of temperate affections, shall pass hand in hand through life, and lie down, not reluctantly, at its protracted close. To them the past will be no turmoil of mad dreams, nor the future an eternity of *such moments as follow the delirium of a drunkard. Their dead* faces shall express what their spirits were, and are to be, by a lingering smile of memory and hope.

(*a*) Give for each of the following a meaning which may be put for it in the foregoing passage: "monopolize," "consummation," "squalid," "*for lack of other victims*," "*war of households*," "a calm bliss of temperate affections," "its protracted close," "no turmoil of mad dreams," "the delirium of a drunkard." [In answer to this question, the candidate should write down simply the expressions he proposes to substitute, without making any further explanation.]

(*b*) What is the real object of the lesson to which this passage belongs?

(*c*) Explain how the "consummation" will produce each of the effects described.

(*d*) Why does Hawthorne add "*not reluctantly*"?

(*e*) With what are "turmoil of mad dreams" and "delirium" contrasted?

(*f*) Explain fully the meaning of the last sentence.

3. Quote from the lessons you have memorized a passage containing one or more noble thoughts.
4. Reproduce in prose "The Burial of Sir John Moore."

COMPOSITION.

Examiner—J. E. Hodgson, M.A.

Note.—70 marks constitute a full paper. A maximum of 5 marks may also be allowed for neatness and writing.

1. Combine the following elements so as to form complex sentences:

(*a*) Parrots abound in the forests of South America. In these forests there is summer all the year around. In these forests the leaves are always green. In these forests the flowers are always blooming.

(*b*) The bison is found in North America. The bison is also found in the northern parts of Europe and Asia. In America the bison is commonly, but erroneously, called the buffalo.

2. Express in your own words the meaning of the following:

(*a*) I dare do all that may become a man;
He who dares do more, is none.

(*b*) All alone by the side of a pool
A tall man sat on a three-legged stool,
Kicking his heels on the dewy sod,
And putting together his reel and his rod.

(*c*) Only in sleep shall I behold that dark eye glancing bright;
Only in sleep shall hear again that step so firm and light;
And when I raise my dreaming arm to check or cheer thy speed,
Then must I, starting, wake to feel—thou'rt sold, my Arab steed.

3. Write a letter to a friend, describing how you spent Arbor Day, or the Queen's Birthday.
4. Correct the following:
(*a*) He is seldom or ever here.
(*b*) Has either of your three friends arrived?
(*c*) I shall neither depend on you nor on him.
(*d*) Neither riches nor beauty furnish peace and contentment.
(*e*) Our *mutual friend arrived yesterday.*
(*f*) The winter has not been as severe as we expected it to have been.
5. Expand the following sentence into a paragraph:
William Tell, the Swiss patriot, having pierced with an arrow the apple placed (for a mark) upon his son's head by the Austrian tyrant, dropped a second arrow; and being asked its purpose, replied that it should have found the tyrant's heart if he had harmed his son.

ARITHMETIC.

Examiner—J. E. Hodgson, M.A.

Note.—100 marks constitute a full paper. A maximum of 5 marks may be added for neatness and writing.

1. Express in words: 17089653.005904, $705.637, and MDCCCLXXXV.
2. Simplify:

$$\frac{7}{47}(3\tfrac{1}{2}+9\tfrac{1}{14})\div \tfrac{1}{13} \text{ of } \frac{£15\ 10s.\ 2d.}{16s.\ 2d.}$$

3. Find the value of $17.6\dot{5}\dot{4}+48\dot{3}\dot{5}+6408$.
4. Make out a bill of the following goods:
23 yds. cotton @ 11c.; 13 yds. gingham @ 23c.
25 yds. flannel @ 37c.; 18½ yds. tweed @ $1.50.
12½ yds. serge @ $1.75; 56½ yds. broadcloth @ $4.50.
5. A merchant purchases sugar at $7.50 per cwt.; at what price per pound must he sell in order to gain 10%?
6. Find the simple interest on $167 for 3 yrs. 9 mos. at 7% per annum.
7. In what time will any sum of money double itself at 6% simple interest?
8. $1,200 is to be divided between two persons, A and B, so that A's share is to B's share as 2 to 7.
9. At what two times between three and four o'clock are the hands of a watch equally distant from the figure III?
10. A man having $720 spends a part of it, and afterwards received 7½ times as much as he spent; he then had $1,305. How much did he spend?

WRITING.

Examiner—J. E. Hodgson, M.A.

1. Write each of the following letters, or combinations of letters, three times:

l, u, m, ch, sp, w, A, W, H, Q.

2. Write the following stanza:

The curfew tolls the knell of parting day,
The lowing herd winds slowly o'er the lea,
The ploughman homeward plods his weary way,
And leaves the world to darkness and to me.

DRAWING.

Examiner—John Seath, B.A.

Note.—25 marks constitute a full paper.

1.—Draw a horizontal line 1 inch long, by the judgment of the eye alone. Indicate its division into half inches by a short, upright line; the division of the half inches into quarter inches by shorter upright lines; and the division of the quarter inches into eighths of inches by faint dots placed on the line.

2. Draw two horizontal lines across your paper, about one inch apart. Beginning at the left lay off towards the right, an oblong two inches in length; skip ⅛ inch, and lay off a square; skip ⅛ inch, and lay off an oblong 3 inches in length.

(*a*) Within the first oblong draw the outline of a portion of any picket fence.

(*b*) Within the square draw the side view of a tea cup. Place the handle on the right side of the cup and draw two horizontal borders, each ⅛ inch wide across the top—one near the top, the other near the bottom.

(*c*) Within the second oblong draw a border, composed of a four-pointed star repeated three times horizontally.

3. Draw a circle two inches in diameter, and within it draw *one* of the following: an octagon, a hexagon, two interlacing equilateral triangles, the interlacing bands being ⅛ inch wide.

4. Draw the following:

(*a*) An oval, having its diameters respectively 1 and 2 inches—the longer diameter being horizontal.

(*b*) An ellipse, having its diameters respectively 1 and 2 inches—the longer diameter being horizontal.

(*c*) A clover leaf, using the diameters of the ovals as construction lines.

N.B.—The ruler may be used, if necessary, to draw the long horizontal lines across the paper in question No. 2, *but for no other purpose.*

Practical Department.

DRAWING.

BY WILLIAM BURNS, DRAWING MASTER, HIGH SCHOOL, BRAMPTON.

(The Editor of this Department will be glad to answer questions for information addressed to him in care of the School Journal.)

I.

Naturally the subject with which we must commence is the *straight line.* First explain to the pupils the meaning of the terms line and straight, curved, crooked or broken, horizontal, vertical, oblique, right oblique, left oblique as applied to lines; not merely by verbal illustration, but by a pictorial representation on the black board. Then test accuracy of this knowledge by a dictation lesson—as an accurate knowledge of the terms used is the foundation of all correctness, *especially in examination work. The first thing* to be noted in the drawing itself is, that all lines should be drawn from left to right. Show this upon the board by assuming any two points at a distance of say 2 feet apart and join these by a straight line. Before drawing the line place the chalk over the left-hand point, then keeping the eye fixed upon the point to be reached try whether you could strike that point, without actually drawing upon

the board. Probably one or two attempts will be required at first. Even when you have drawn a straight line let it be marked very lightly at first, and afterwards strengthened in when seen to be accurate. These remarks apply equally to pencil drawing, let every line be tried first, then lightly drawn and only strengthened in when the figure, whether simple or elaborate, is quite completed. Having drawn one straight line in the above positions, next let a series of lines be drawn parallel to each other. In order to get these of equal length, draw lightly two bounding lines one on each side—then, suppose the question is to draw five parallel lines, divide these lines into five equal parts, and draw lightly the lines joining the points, and after erasing lines of construction, strengthen in the lines containing answer. Adopt this plan in every picture. In order to prove the parallelism of these lines, let the pupil hold the paper obliquely so that he looks down the paper, and the least irregularity will be apparent; it is obviously better to let the pupil discover his own errors, than for the teacher to point them out. As an exercise in parallel lines the pupil may draw a picture of an ordinary door with its four panels.

Next draw two lines ten times longer than their breadth; make the ends to represent the broken or torn ends of slips of wood or paper. Then supposing one of these to be laid over the other, it is plain that a portion of the lower will be invisible. Show the pupils how to represent this by erasure of hidden portion, but be sure that the full line is drawn at first, otherwise there will be an incorrectness in the work. This exercise may easily be extended, so as to show three or more slips crossing one another, at right angles, then obliquely. Extend this idea by taking a slate, and asking the pupils to draw outline of it. Having this done correctly, hold up before the class two slates, so that a portion of one is covered by the other. Let these be drawn first as if both were visible, then let the picture be completed as seen by the class. Thus we have obtained even by straight lines only, the most interesting kind of drawing for the pupils, namely, object drawing, and have shown practically the use of the study. A picture of a window with rectangular panes of glass, and afterwards of one with rhomboidal panes will furnish a good lesson in straight line drawing. In combination with these practical drawings the use of simple scales may well be taught Suppose we notice one of the windows of the school-room. Ask the class its size; tell them to draw it. You will naturally get the reply that the paper is too small. Then you can easily explain that by representing every foot of the window by an inch on the paper, a picture is produced similar in every respect to the object before the class Hence one inch on the paper will represent one foot of object, or you have scale of $\frac{1}{12}$. Similarly all simple scales can be explained by any intelligent teacher. As an exercise the following question may well be given: Draw picture of portion of common picket fence with straight upright pickets and horizontal bars. Let the picture be 6 inches long and let the pickets be each $\frac{1}{2}$ inch wide with $\frac{1}{2}$ inch intervals, height 4 inches and rails $\frac{1}{2}$ inch from top and bottom and also $\frac{1}{2}$ inch wide. Any error in such an exercise is easily seen by the most experienced eye. Such questions will train the pupil in correctness of work. Practical examples may be indefinitely multiplied; as, an ordinary gate, a pair of shutters, and numerous objects of common occurrence.

Educational Notes and News.

The Shelburne School Trustees have requested the Council to take advantage of the amendment to the School Act, which permits the election of school trustees at the same time and place and in the same manner as the election of municipal councillors, and to make arrangements accordingly.

Brantford Ladies' College is arranging its course so as to cover the ground of the junior and senior matriculation examinations in the University of Toronto.

Miss Bessie E. Hadman, the newly appointed principal of the Kindergarten Department of the Toronto Normal School, is a graduate of Cook County Normal School, Illinois, and comes with the recommendation of *Colonel Parker, the somewhat celebrated* Principal of that school.

A college of music is about to be established at Paris on a comprehensive plan. There will be, besides a free school of music, a theatre capable of holding 2,000 persons, concert and lecture halls, a dancing school, an exhibition of painting, sculpture and architecture, a free school of painting on china, an artists' club, in which gambling will be strictly prohibited, an immense fencing hall, billiard rooms, conservatory, shooting gallery, library and reading rooms, and finally a wing containing forty small suites of apartments, which will be reserved for the foreign members of the club.

Mr. John Houston, formerly teacher in the London Collegiate Institute, but latterly at Portage la Prairie, has received the offer of the English mastership in the Kingston Collegiate Institute.

From the annual report of the Inspector of Public Schools of the County of Glengarry for the year 1884 it appears that the highest salary paid to a male teacher was $550, the average being $336.41, and lowest $180; highest paid to female teachers—$330, $325, $320 and $300, average $219.92, and lowest $160. There are in Glengarry County six brick school-houses, thirty frame, and thirty-seven of log; many of the latter are clapboarded, lathed and plastered. The following facts show some of the difficulties with which teachers in that county have to contend:—The total number of pupils' names entered on the school registers during the year was 4,429 (2,385 boys and 2,044 girls), with a yearly average attendance of 1,805. Of the whole number enrolled, 423 attended less than 20 days, 904 between 20 and 50 days, 1,201 between 51 and 100 days, 1,098 between 101 and 150 days, 681 between 151 and 200 days, 119 between 201 and 222, the number of teaching days in the year.

Mr. Peter Campbell, M.A., Toronto, has been appointed Principal of the Hamilton Collegiate Institute *vice* Mr. Dickson, now principal of Upper Canada College.

Mr. G. W. Vanslyke, late Head Master of the Ingersoll Public Schools, has accepted a similar position in the Woodstock Public Schools.

The last report of the committee of the British Privy Council of Great Britain, on Education, contains the following statistics:—Number of pupils on the books, 4,337,321; average attendance, 3,273,124. At the examinations, 1,534,629 out of 2,342,521 passed without failure in any of the three branches prescribed—reading, writing, and arithmetic; 90.78 scholars out of every 100 passed in reading, 82.42 in writing, and 77.53 in arithmetic. With the increase in population, which may be estimated at 1.35, education does more than merely hold its own. The number of school houses increased by 3.45 per cent., the scholars on the rolls by 1.5 per cent., and the average attendance by 4.67 per cent. The Government grant is increased by £200,000, or about 6½d. per head. The average salary of a certified master, which was £95 in 1870 is now £119, and that for school mistresses has risen from £58 in 1870, to £72 in 1884. About 30 per cent. of these teachers are also provided with residences free of rent. In Scotland a school master's salary was, in 1870, £102, now it is £135; school mistress, £56 to £66.

The high schools of Massachusetts are fitting thirteen hundred young men for college every year; the primary schools are fitting more than one hundred and thirty thousand children for the training of the higher schools. Interesting as it is to consider the regiment that annually marches into college, it is of greater moment that an entire army of little folk marches annually onward to the higher grades.—*The American Teacher.*

Leamington Public School sent up three pupils to the recent Entrance Examinations, all of whom passed. Of six third-class candidates, three passed.

Dr. Jack, who has been for many years President of the University of New Brunswick, and Professor of Mathematics in that institution, has resigned.

Mr. Charles D. Roberts, M.A., for some time editor of *The Week*, has been appointed to the Chair of English Literature in King's College, Nova Scotia.

TEACHERS' CERTIFICATES.

Third Class Non-Professional Certificates.

160. Candidates for a Third Class Non-Professional Teacher's Certificate will be examined in the following subjects as prescribed for Form I. of the High School Course of Study, viz :—Nos. 1-10, 19, 20, and 21, with an option between 15, 17, 18, and group 12 and 14

161. When a Third Class certificate has expired, the holder thereof may, on passing the Departmental examination, obtain a renewal of the same for a period of three years, subject to attendance at a County Model School, at the discretion of the County Board of Examiners.

162. In the case of such applicants for a renewal of Third Class Certificates as take the minimum number of marks in each subject, but fail in the aggregate, a bonus not exceeding 200 marks for efficiency and aptitude in teaching will be allowed on the report and at the discretion of the County Inspector.

163. A holder of a Third Class Certificate who passes the Non-Professional examination for any certificate of a higher grade shall, on application to the County Board of Examiners, and on proof of his efficiency as a teacher, be entitled to have such Third Class Certificate extended, by endorsement, for a period not exceeding three years from the date of such examination, but no certificate shall be extended for a longer period than three years without re-examination.

164. In case of an emergency, such as a scarcity of teachers, or for any other special cause, Third Class Certificates may be extended by the Minister of Education, on the joint request of any Board of Trustees and the County Inspector ; but all such extensions shall be limited to the school on whose behalf the request is made.

165. A temporary certificate may be given by the County Inspector under the conditions stated in regulation 51 (14).

Second Class Non-Professional Certificates.

166. Candidates for a Second Class Non-Professional Teachers' Certificate will be examined in the following subjects as prescribed for Form II. of the High School Course of Study, excepting Ancient History and Geography, viz :—Nos. 1-10, 13, 21, with an option between 15, 17, 18, group 12 and 14, and group 19, 20, and 23. Candidates who do not take the commercial option for Second Class, shall pass the Third Class Non-Professional examination in Nos. 19 and 20. Only such candidates as pass the Second Class Non-Professional examination will be eligible to write for First "C," but both examinations may be taken the same year.

First Class Non Professional Certificates—Grade C.

167. Candidates for a First Class Non Professional Certificate, Grade C, will be examined in the following subjects as prescribed for Form III. of the High School Course, viz.:—Nos. 3, 4, 5, 6, 7, 9, 10, 11, 13, and 14 of Form III., and also 12 of Form II. At the examination in Botany, candidates will be expected to describe and classify a submitted specimen of a Canadian flowering plant.

168. Candidates who, in addition to the Departmental Second Class Non-Professional examination, have passed the junior matriculation examination of Toronto University with first class honors in Mathematics, English, and History and Geography, or an equivalent examination in any of the chartered Universities of Ontario, shall be awarded a First C Non Professional certificate without further examination.

Grades A and B.—Non-Professional.

169. Candidates for a Departmental Certificate, Grade A or B, taking the Departmental Examinations, shall not be eligible to write for this grade until they have first passed the examination required for Grade C, but nothing herein contained shall prevent a candidate from writing at both examinations the same year. A candidate for Grade A or B will be allowed an option between English and Mathematics.

170. Graduates in Arts who have proceeded regularly to their degree, and who, at their final examination, have taken First or Second Class Honors in one of the departments of Science, Classics, Mathematics, or Modern Languages, or in the department of Mental and Moral Science and Civil Polity, shall, on application to the Education Department, receive a First Class Non-Professional Certificate, Grade A or B, according as the honors were First or Second Class.

171. Non-Professional examinations for First Class Certificates, Grade A or B, shall be limited as follows :—

Department of English.

Composition.—History and Etymology of the English Language ; Rhetorical Forms ; Prosody.

Books of Reference : Earle's Philology of the English Tongue ; Abbot and Seeley's English for English People, Bain's Composition and Rhetoric, or Hill's Rhetoric ; Marsh's English Language and Literature, Lectures VI. to XI. inclusive.

Literature :

1. History of English Literature, from Chaucer to the end of the reign of James I. Books of Reference : Craik's History of the English Literature and Language, or Arnold's Literature, English Edition ; Marsh's English Language and Literature, Lectures VI. to XI. inclusive.

2. Specified works of standard authors as prescribed from time to time by the Department.

History :

Greece.—The Persian to the Peloponnesian War inclusive.—Cox's History of Greece (unabridged).

Rome.—From the beginning of the Second Punic War to the death of Julius Cæsar.—Mommsen's History of Rome.

England.—The Tudor and Stuart Periods, as presented in Green's Short History of the English People, Macaulay's History of England (or Franck Bright's History of England, Second Volume), and Hallam's Constitutional History.

Canada—Parkman's Old Regime in Canada and Wolfe and Montcalm.

Geography :

So much Ancient Geography as is necessary for the proper understanding of the portions of the Histories of *Greece and Rome* prescribed.

Department of Mathematics.

Algebra.—Symmetry, Binomial Theorem, Multinomial Theorem, Exponential and Logarithmic Series, Interest and Annuities, Indeterminate Coefficients ; Partial Fractions, Series (Convergency and Divergency, Reversion, Summation), Inequalities, Determinants as far as in Gross, Reduction and Resolution of Equations of first four Degrees and of Binomial Equations, Relations between Roots and Coefficients of Equations, Indeterminate Equations, Problems.

Analytical Plane Geometry.—The Point (including Transformation of Co-ordinates), the Right Line, the Circle, the Parabola, the Ellipse, the Hyperbola, the General Equation of the Second Degree, Abridged Notation.

Trigonometry.—Trigonometrical Equations, Solution of Triangles, Measurement of Heights and Distances ; Inscribed, Circumscribed, and Escribed Circles of a Triangle ; Quadrilaterals, Description of Vernier and Theodolite, Trigonometrical and Logarithmic Tables, Demoivre's Theorem.

Statics. Equilibrium of Forces acting in one plane ; Parallelogram of Forces, Parallel Forces, Moments, Couples, Centre of Gravity, Virtual Work, Machines, Friction, Experimental Verifications.

Dynamics.—Measurement of Velocities and of Acceleration, Laws of Motion, Energy, Momentum, Uniform and Uniformly Accelerated Motion, Falling Bodies, Moments of Inertia, Uniform Circular Motion, Projectiles in Vacuo, Collisions, Simple Pendulum, Experimental Verifications.

Elementary Geometrical Optics.—Reflection and Refraction of Light at Plane and Spherical Surfaces, including Prisms and Lenses (aberration not considered) ; the Eye ; Construction and use of the more simple Instruments.

The following books are recommended for reference in addition to those prescribed for Grade C :—

Algebra—Gross & Todhunter.
Analytical Geometry,—Vyvyan and C. Smith. Refer to Salmon.
Trigometry.—Hamblin Smith ; Refer to Colenso or Todhunter.
Dynamics —Garnet, or Gross's Kinematics and Kinetics.
Geometrical Optics. —Aldis.

Valuation of Subjects for First, C, Second and Third Class Non-Professional Certificates.

172.—The values of the different subjects in which candidates for Non-Professional Certificates will be examined, shall be as follows : —Reading (oral), 50 marks ; Reading, Principles of, 50 ; Orthography and Orthoepy, 50 ; English Grammar, 150 ; Composition,

100; Literature, Poetry and Prose, 200; History, 100: Geography, 75; Arithmetic, written and Mental, 200; Algebra, 100; Geometry, 100, Trigonometry, 100; Physics, Chemistry and Botany, each, 100, Latin, French, and German, each, 200, Writing, Book-Keeping and Commercial transactions, Precis-writing and Indexing, 200; Drawing, 75.

173. Any candidate who obtains one third of the marks in each subject, and one half of the aggregate marks obtainable, shall be entitled to rank as the holder of a non professional certificate of the class for which he is such candidate.

PROFESSIONAL CERTIFICATES.

174. The holder of Third Class Non-Professional Certificate, who takes the course and passes the examination prescribed for County Model Schools, shall be entitled to rank as a Third Class Teacher of Public Schools.

175. The holder of a Second Class Non-Professional Certificate, who has taught a Public School successfully for one year, and who attends a Provincial Normal School one session, and passes the prescribed examination, shall be entitled to rank as a Second Class Teacher of Public Schools.

176. Any Graduate in Arts with Honors as prescribed in Regulation, 170, or the holder of a First Class Non-Professional Certificate, who has passed an examination at a Provincial Normal School, and who attends a Training Institute one Session and passes the prescribed examination thereat, shall be entitled to rank as a First Class Teacher of Public Schools or an Assistant Master of High Schools.

177. Any teacher who holds a First Class Non-Professional Certificate and a Second Class Professional Certificate, and who has taught successfully for at least two years in a Public School, High School, or Collegiate Institute, shall be entitled to rank as a First Class Teacher or Assistant Master of a High School, on passing the final examination prescribed for a Training Institute, without attendance thereat.

SPECIAL SUBJECTS FOR 1886.

CLASS III. ENGLISH LITERATURE:

Macaulay—Essay on Warren Hastings.

Coleridge—Ancient Mariner, Ode to Dejection, Ode to France, to William Wordsworth, Youth and Age, Ode to the Departing Year.

LATIN:—*Cæsar*—Bellum Britannicum.

FRENCH:—*Souvestre*—Un Philosophe sous les Toits. First four chapters.

GERMAN:—*Grimm*—Kinder-und Haus-Märchen (Williamson's Edition) to end of Selection, Brüderchen und Schwesterchen.

CLASS II. ENGLISH LITERATURE:

The same as for Class III., but the questions will be distinct and of a more difficult character.

LATIN:

Cæsar—Bellum Britannicum.
Cicero—Cato Major.
Virgil—Æneid (bv i.—304).

FRENCH:—*Souvestre*—Un Philosophe sous les Toits.

GERMAN:—*Grimm*—Kinder-und Haus Märchen.

CLASS I.—GRADE C. ENGLISH LITERATURE:

Shakespeare—Merchant of Venice.
Coleridge and *Macaulay*—(As for Classes II. and III.)

CLASS I.—GRADES A and B. ENGLISH LITERATURE:

Shakespeare—Merchant of Venice.
Chaucer—Prologue to the Canterbury Tales. The Knight's Tale.
Pope—Prologue to the Satires.
Tennyson—Enid and The Passing of Arthur.
Wordsworth—Ode on the Intimations of Immortality.
Addison—The Selections from Addison's Contributions to the Spectator, made by J. Arnold, under the headings (1) Manners, Fashions, and Humours; and (2) Tales and Allegories.
Macaulay—Life and Writings of Addison.

The following editions of the above are mentioned for the information of candidates: *Chaucer*, Clarendon Press; *Pope*, Clarendon Press, *Addison*, Clarendon Press.

Candidates are recommended to consult the following books of reference: Dowden's Mind and Art of Shakespeare, or Gervinus' Commentaries, English-Men of Letters, Stedman's Victorian Poets, Hutton's Literary Essays, Tainh's Study of Tennyson.

Literary Chit-Chat.

Ginn & Co. announce to be ready about September 20th a new work for the use of those who wish to read and understand music, entitled "Pease's Singing Book."

The approaching visit of Archdeacon Farrar to America is awaited with a good deal of interest. Amongst the subjects on which he is expected to lecture in the United States are Dante, Robert Browning's Poems, and The Talmud and its Authors.

Admiral Porter's "Anecdotes and Incidents of the Civil War, will be published this autumn by D. Appleton & Co.

The Pope has distributed among the Cardinals copies of his Latin poems, printed on rose paper, in Elzevir type, with illuminated borders and rich engravings.

Macmillan & Co., are to publish early in the fall a special American edition, carefully revised, of Dr. Martineau's "Types of Ethical Theory."

A book that will be most interesting and useful, if carefully and reliably prepared, is promised by Funk & Wagnalls. It is to be a record of the first century of the temperance conflict, edited by the Rev. Wilbur F. Crafts, and entitled "What the Temperance Century has Made Certain." It will contain letters from Neal Dow, Dr. Cuyler, President Seelye, Joseph Cook, and many others.

A new edition of "Uncle Tom's Cabin," printed from new plates, is to be brought out by Houghton, Mifflin & Co.

The "Bread-winners" has been translated into French, German, and Swedish, and has been included in the Tauchnitz "British Authors." It is said that Harper & Brothers have sold 25,000 copies and that 3000 copies have been sold in Australia.

Literary Review.

SHAKESPEARE, SELECT PLAYS. TWELFTH NIGHT, OR WHAT YOU WILL. Edited by W. Aldis Wright. One of the best auxiliaries to the revival of the reading and study of the English Classics, is the production of cheap and yet tasteful editions, with necessary annotations. The Series of Select Plays from Shakespeare, issuing from the Oxford Clarendon Press, is at the same time one of the most scholarly and most attractive of these editions. Twelfth Night will maintain and enhance the reputation of these volumes. It is neatly bound in limp cloth, the preface is an interesting specimen of historical criticism; the notes are simple and yet scholarly, and the lights thrown upon obscure and difficult passages will be appreciated by many besides the School and College Students. For Sale by Williamson & Co., Toronto.

TRIPERTITA. (FIRST SERIES.) A COURSE OF EASY LATIN EXERCISES FOR PREPARATORY SCHOOLS. By Frederick T. Holden M.A., Late of Emmanuel College, Cambridge; Assistant Master at Casselfield Preparatory School, Edinburgh.

EASY PIECES, FOR LATIN PROSE. (FIRST SERIES.) By A. C. Champneys, M.A., and G. W. Randall, M.A., Assistant Master at Marlborough College. These two little books from Rivingtons, London, are admirable in their way, and show that English Teachers are now in the the foremost ranks amongst those who are striving to smoothe the way of the Tyro to the complexities of the Latin Accidence and Syntax. The first is a course of easy Latin Exercises for preparatory schools. On one page are arranged a series of simple English Sentences, designed to illustrate in order the various inflections etc., and on the opposite are given the uninflected forms of the Latin Words required, the whole book being thus a series of exercises in transferring Easy English Sentences into Latin. "The Easy Pieces deals in a somewhat similar progressive way, with Syntactical difficulties, and gives the vocabularies required at the end of each exercise. The exercises in this are prefaced with some simple rules on the use of the Relative, Sequence of Tenses, Oratio Obliqua &c. As we turn over the pages of such works, and contrast them with the dry and hard text-books of our school days, we are tempted to envy the Tyros, whose lines have fallen to them in such pleasant places. It is to be hoped that the increased requirements of examiners in the way of "Sight" reading of the classics, will encourage the introduction to a larger extent of such simple yet Philosophical text-books in our Canadian Schools.