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THE

SCHOOL MAGAZINE.

NOVEMBER, 1880.

THE SCHOOLS OF GERMANY.

IT is not our intention in this short paper to attempt anything like an exhaustive analysis of the German School System. We shall briefly notice some prominent features in the origin, growth and present efficiency of the Prussian schools that seem striking and suggestive.

Up to the time of King Frederick William I., the second king of Prussia, the elementary schools of Prussia had been a department of the Church, and were wholly controlled by it. Under this king one thousand eight hundred (1,800) elementary schools were established, and teaching became a recognized science the theory of pedagogy having been made an indispensable requirement for the office of a public teacher.

The first general school law for the Prussian Monarchy was issued October, 1713. Frederick the Second (Great), promulgated a code of "General School Regulations," prescribing the general obligation to attend school fixing the school age of the pupils, payment of fees, fines, &c., &c.

Frederick William II., the successor of Frederick the Great, established at Berlin in 1787 an Oberschul Collegium (High School Commission), for the examination of teachers. This was an important move in the direction of obtaining well qualified persons as teachers. The Prussian Common Law of 1794 declared all EDUCATIONAL INSTITUTIONS, including Universities, State institutions.

In the reign of Frederick William III., Ernestine von Krosigh had the courage to establish a seminary for female teachers in Berlin (1804). This noble king did not allow the great national calamity which befell Prussia and Germany shortly afterwards to altogether retard the progress of elementary school education. His words are highly prophetic: "Although we have lost territory, power and prestige, still we must strive to regain what we have lost by acquiring intellectual and moral power; and, therefore, it is my earnest desire and will, to REHABILITATE THE NATION BY DEVOTING A MOST EARNEST ATTENTION TO THE EDUCATION OF THE MASSES." National education, no more entrusted to the care of a subordinate committee became a distinct branch of State administration, and was until the close of 1811 under the immediate charge of Wilhelm von Humbolt, afterward under von Schackman. In 1818 von Altenstein was appointed to the newly established Ministry of Educational Affairs. The national education developed most rapidly. At the time of Altenstein's death (1840), there were 6 Universities, 120 Colleges, a still larger number of real Schools, 38 Teachers' Seminaries, and about 30,000 Public Schools. Every sixth inhabitant of the kingdom was attending school. Eichorn's System, which began in 1840, and, which was in some respects inimical to Protestantism, was overthown by the Revolution of 1848. At the close of 1861 there were out of a population of 18,476,500, 2,875,836 children actually attending —number of schools, 24,763; teachers, 35,372. The aggregate of expenditure for the eight old Provinces of Prussia in 1861, was 9,902,696 thalers; 31.16 per cent. of this was raised by the people; 64.44 per cent. by the taxation of communities, and only 4.40 per cent. by appropriations on the part of the State. For the entire German Empire in 1872 the total number of elementary schools are estimated at about 60,000; teachers about 110,000; pupils about 6,500,000, or more than 15 per cent. of the entire population. The law of March 11, 1872, confers the right of supervising all educational institutions, public and private, upon the State—the State at the same time recognizing the co-operation of local authorities as established by law. The State Ministry of ecclesiastical, educational, and medical affairs in Berlin governs all the educational institutions of the Monarchy.

To form an idea of the kind of teaching done in the public schools of Germany it will be necessary to consider the course of instruction as well as the examination of candidates laid down in the Allgemeinen Bestimmungen (General Regulations) of Oct. 15, 1872. According to these regulations the Royal Seminaries have three classes, EACH WITH AN ANNUAL COURSE OF INSTRUCTION. The two lower classes are instructed in

A WEEK.

Pedagogics. - - - -	2	hours.
Religion, - - - -	4	"
German Language, -	5	"
Geography - - - - -	2	"
History, - - - -	2	"
Gymnastics, - - - - -	2	"
Arithmetic, - - -	3	"
Geometry, - - - - -	2	"
Natural Science, - -	4	"
Music, - - - - - -	5	"
Drawing, - - - -	2	"
Penmanship, - - - - -	2	"

and either French or Latin, three hours a week, according to option of pupils. The students of the higher class drop penmanship. The instruction in pedagogics embrace the most important points of phychology. Instruction in German must illustrate the divisions of lyric, epic, didactic and dramatic Poetry. In addition to the history of Prussia and Germany pupils receive a course of Greek and Roman history.

Natural science is taught to the youngest classes in the German public schools, botany and object lessons going hand in hand. The observing faculty in a child is sooner developed than the analytic or the reflective. You are therefore able to effect more in primary teaching by using the mental powers as they are naturally unfolded. Children between 7 and 13 years old may be seen carrying huge baskets full of botanical specimens to school. The teacher gives the children the popular name of the plant, analyses its flower, and explains its uses, &c. The American tourist, who meets in his rambles with a plant he does not know, may have a school boy or girl make known to him the name, history and peculiarities of the stranger. Advanced classes receive instruction in zoology, geology and physiology. In many parts of the Sudetic Mountains the non-fossiliferous and fossiliferous rock masses and minerals of the district are beautifully exhibited in the building of the public school. Many of the LARGE CITIES of Canada lie wholly outside this culture.

In the Gymnasia and Real Schulen (real schools), a sound basis for general scientific and literary culture is laid—the former supplying a philosophical and liberal education—the latter a practical one. A complete gymnasium has six grades, Sexta being the lowest, and Prima the highest. The upper grades from the third to the first are divided into two divisions—a lower and a higher. The full course comprises a period of nine years. Candidates for the lowest are required to have completed their nine years, and to have passed a satisfactory examination in the elementary branches of a common school education. We give the number of weekly recitations in each grade.

	Sexta	Quinta	Quarta	Tertia { Upper / Lower	Secunda { Upper / Lower	Prima { Upper / Lower
Religion,	3	3	2	2	2	2
German,	2	2	2	2	2	2
Latin,	10	10	10	10	10	8
Greek,	..	..	6	6	6	6
French,	..	3	2	2	2	2
History and Geography,	2	2	3	3	3	3
Geometry and Arithmetic,	4	3	3	3	4	4
Physics,	..	..	..	..	1	2
Natural History,	2	2	..	2	..	..
Drawing,	2	2	2	..	..	..
Penmanship,	3	3	..	..	..	..

You cannot compare the classical culture of the ordinary graduate of our Universities with that of the students of the German Gymnasium, who have studied Latin ten hours a week for nine years, and Greek six hours a week for seven. During the last years of the student's stay at the Gymnasium Latin is almost the only language spoken or written. The student's translations of Greek, the lectures he hears from his teachers, and the criticisms he makes of the Greek or Roman author are all made in Latin. In the real schools more attention is paid to the modern languages, the higher mathematics and natural science. The successful completion of the course of the Gymnasium gives the student a full introduction to the University, and places all its honours within the range of his competition.

HISTORY IN OUR PUBLIC SCHOOLS.

G. W. Johnson, H. M. M. S., before the Wentworth Teachers' Association, October 16th, 1880.

I do not come before you expecting to show you some new thing, but rather to illustrate the plan pursued in teaching History in the Hamilton Public Schools. As a rule no subject in the school curriculum is less *taught* or worse *crammed* than history; and this arises, in a great measure, from the fact that many teachers are not, themselves, "well up" in the subject, and hence have, as they confess, no taste for it. It will generally be found that when a teacher says "I dislike teaching Arithmetic," he is not himself possessed of a "massive mathematical intellect;" when he says, with a sigh, "Grammar is such a dry study," he is not, himself, a finished grammarian; and when he says "I hate History," his reading and understanding of the subject are very limited indeed.

When we begin the History of a country we ought first to examine its geographical position and physical condition, and learn all we can of its surroundings, climate, soil and productions, and then take into consideration its political relations with neighboring lands so as to be able to understand *how* these conditions and surroundings are *likely* to affect it.

WRITTEN ON THE BLACK-BOARD FOR DISCUSSION.

(1.) *The* EARLY *history of a country* MUST *be taken up with its geography.*

To properly understand the history of a people we *must* be thoroughly conversant with the physical geography of the country and its surroundings, in order to grasp intelligently the many influences which have wrought its revolutions or contributed to its peace and prosperity. Who shall determine how much of a nation's importance or insignificance is due to its geographical position? Nearly all of Turkey's troubles during the present century are traceable to this source. The geographical position of empires influences their wars and revolutions. Perhaps an exception ought to be made in the case of Mexico which has its new revolution every morning for breakfast, without any assignable cause.

(2.) *The physical and political aspects are* INSEPARABLE.

They are building a fine edifice on the corner of King and Hughson streets, and over the door a sculptor is chiselling the British Arms. A week ago it showed only a rude outline of the intended figures, but all its parts, though half hidden in the stone, could be plainly discerned. Day by day it has been growing under the mallet and chisel and assuming fairer and more symmetrical proportions. The artist will continue to hew, here a little and there a little, till it stands forth in all its beauty. What opinion would you have of his skill had he a week ago begun his work by carefully chiselling out and polishing up a paw of the lion, next day, perhaps, the unicorn's horn, and so on, day after day working it out piecemeal? What is your opinion of the teacher who attempts to teach the history of a nation without at first "blocking out," in rude outline it may be, its whole history, from its earliest times to the present, and then, day after day, touching it up, here a little and there a little, never allowing the historical thread to become tangled or broken, until the whole fabric in its symmetry and completeness is indellibly impressed on the pupils' minds; begins by polishing up a reign (a paw, so to speak) and next day another, and hopes in this piecemeal fashion to give his pupils any intelligent, connected idea of the political life of a nation and the causes that have contributed to its prosperity or decay?

(3.) *First a brief outline of the entire subject.*

This outline should contain few dates and be the successive steps the nation has taken from barbarism to present civilization—epochs in the political life of the nation, and not a record of its wars and the genealogy and personal peculiarities of its sovereigns. Classifications or divisions by centuries or the reigns of successive monarchs do not attain this object. The proper course to follow is to divide the history of the country into epochs, each being marked by one great event. English history would thus present itself under an outline similar to the following:—

B. C. 55, Barbarism—Roman occupation—Saxon invasion—Danish inroads—Norman Conquest—Rise of the Commons—Reformation—Revolution—Party Government—Long Peace—A. D. 1880. Such an outline would contain all the facts of first importance upon which, as a base, should be built and grouped the incidents of a subordinate nature, which go to make up the finished history. Upon this base-line should be laid successive layers of information, facts and inferences, care being taken that the historical thread is never tangled or broken, till out of indefiniteness grows a finished, connected idea of the whole.

(4.) *Outline by epochs and teach as a whole.*

Let the epochs be the foundation upon which you build; do not exhaust one epoch and then proceed to the next; the builder does not build his house gable at a time, but he lays his bricks in courses; build up your historical structure in layers and preserve the unity or connectedness of the whole, so that the line of history once laid down shall never be broken. I have repeated this idea because I consider it all-important. As you proceed with layer after layer till the structure is complete it will be found necessary to supply fuller dates, but even then only important ones should be given, to junior pupils at least. The dates of unimportant battles and minor incidents such as the institution of the Curfew Bell, the Meal-tub plot, the Great Fire of London, the Massacre of Glencoe, and the like, have little to do with the true history of England. Some dates, however, are really essential.

(5.) *A* WELL-SELECTED *chronology is important.*

Do not teach your pupils to measure the prosperity and greatness of a nation by its warlike achievements, but, instead, give prominence to the progress of the people in political and personal freedom, the development of its social condition, as indicated by its growing skill in arts and manufactures, agriculture and commerce; mutual intercourse and amusements; and its advancement in intellectual, moral and religious cultivation, as depending on the diffusion of literature, the founding of schools and the like. You will find that these topics are not only more instructive and civilizing than military history, but can be made equally interesting to pupils.

(6.) *Teach the biography of the nation, not of its kings.*

The live teacher of a public school will doubtless feel that his pupils are much less concerned with the *early* history of a country than with the *later*, and will pass lightly over periods which have no palpable or vital connection with the present state of it, and will dwell most on those that have determined its *modern* institutions. The Roman Occupation, the Saxon Invasion, the Danish Inroads and the Norman Conquest may be fitly termed the ancient history of England. Their connection with the present is, at least, remote and incapable of being realized by the average public school pupil; but the periods of the Reformation, the Revolution, the Reform of Parliament, and the like, stand in a very different position.

(7.) *Dwell lightly on the period before the Norman Conquest.*

When the successive layers of historical knowledge have been built upon the foundation first laid in epochs; when the stream of history has been traced from its source to the present time; when the position to which the course of past events has brought the country is thoroughly comprehended, it will be time enough (and then only with adult pupils) to investigate the philosophy of History in general. Undoubtedly the design of the study of History is not alone to acquire knowledge, but to form the judgment so that it shall be able to apply the lessons of past times to the present.

(8.) *History enables us to judge of the past as of the present.*

Let us now apply the scheme thus

laid down to the study of English History by beginning with that portion of it which *must* be studied in connection with its geography. First sketch on the black-board, in the presence of the class, an outline of Europe and Britain, and dwell briefly upon the state of the country and the modes of life and habits of its people at the time of our earliest knowledge of it. It would be easy to show the route taken by the Romans and why they took it; why those Roman walls were built, and how the habits of the people gradually changed under the Roman rule; why the Romans abandoned the country, and the natural result of this abandonment—the rushing in of the northern robbers upon a fine agricultural country; why the Saxons came over and rescued the country from the Scots only to keep it themselves; how another change in the life of the people followed; how natural and easy it was for the Danes to come; and finally the not-to-be-wondered-at Norman Conquest. Thus in one or two lessons can be taught all that is necessary for young historians to know of the *early* history of Britain. With the Norman Conquest begins the true history of England. We may now begin to build upon the "Epoch Foundation" laid down as before described. The first layer upon this would perhaps be to divide the period from 1066 to 1880 into Houses; but observe that this division by Houses does not correspond with the division by epochs :—

Four Normans from ten sixty-six ruled o'er
The Land, till 'leven hundred and fifty-four.
Then followed the potent Plantagenet line—
Eight sovereigns--it ended thirteen ninety-nine.
Lancaster and York proved a quarrelsome hive,
Six sovereigns—it ended fourteen eighty-five.
The great House of Tudor next followed we see—
Five sovereigns—it ended sixteen hundred and three.
James Stuart, sixth of Scotland, was first of his line—
It broke with his son in sixteen forty-nine.
The Commonwealth followed eleven years more,
When the people were willing the Stuarts to restore.
The Stuarts, sixteen sixty again ruled the State--
James, the last, was dethroned, sixteen eighty-eight.
The Orange-Stuart line's double sovereigns are seen
To close with Qeeen Anne, seventeen hundred fourteen.
The Brunswick or Hanover line, it's well known,
Has had its six sovereigns and still has the throne.

Perhaps the next layer of historical knowledge would be to name the successive sovereigns.

First William, the Norman, then William, his son,
Henry, Stephen and Henry, then Richard and John;
Next Henry, the third, Edwards—one—two and three,
And again, after Richard, three Henrys we see;
Two Edwards, third Richard, if rightly I guess,
Two Henrys, sixth Edward, Queen Mary, Queen Bess;
Then Jamie, the Scotchman, and Charles whom they slew,
Yet, after two Cromwells, took Charles number two;
Next Jamie, the second, who stopped at no crime,
And William and Mary, who reigned at one time;
Good Anne, Georges four, fourth William all passed,
And Victoria came—may she long be the last.

Upon this build layer after layer of facts, causes and results, till the structure is complete.

Similarly take up Canadian History, beginning with that part which *must* be taught in connection with its geography—from 1492 to 1608, the founding of Quebec. You will perhaps consider it desirable to refer to the

Discovery of America, and to do so you again have recourse to the blackboard. Represent on it the hemispheres of a globe in use in the time of Columbus. The Eastern Hemisphere will be much the same as now except that it will contain only a portion of Asia; the rest will occupy the western half of the Western Hemisphere, showing the Atlantic stretching from Europe to Asia. To reach India three courses were open to Columbus; namely, overland, or down around Africa and across the Indian Ocean or across the unknown Atlantic. Columbus chose the last and when he reached the Bahamas, where according to his globe, India ought to be, he naturally supposed he was in India. Hence the name Indians as applied to the inhabitants. But it wasn't India at all but a New World upon which he had stumbled, and he died without finding it out. It will be easy to show that the Spaniards having gained a foothold in the central and southern parts of America are there yet. England next sent the Cabots more directly across and laid claim to the country, part of which is now called Canada. Jacques Cartier, for France, did the same some forty years afterwards, and the rival claims thus established led to troubles many years afterwards. A couple of lessons will make this intelligible to pupils. Then dropping that part of the history of Canada which *must* be taught in conjunction with its geography we come to Canadian history proper which begins with the founding of Quebec 1608. Lay now the "epoch foundation": 1608 to 1759, French domination; 1759 to 1792, British military rule; 1792 to 1840, Representative Government; 1840 to 1867, Responsible Government; 1867 to 1880, Dominion of Canada. Then build upon this foundation as before, never allowing the line to be broken; and instead of indefiniteness your pupils will have a clear, connected idea of the history of their country.

Thus have I given you, as briefly as I could, the plan pursued in teaching History in the Hamilton Public Schools. It has been found to work well.

TEACHING CHILDREN TO READ.

By Miss C. A. Jones Blair.—Published by request of the Waterloo County Teachers' Association.

IT is not my purpose to speak of reading in the sense of learning to pronounce words correctly, and give their proper inflections; or to discuss the respective merits of the alphabetic phonetic, look and say, or phonic methods of teaching it; but to present a few thoughts on the importance of cultivating in the youth of our schools a love for the thoughtful reading of good and instructive books. In these days of cheap newspapers and books considerable progress has been made in this direction. Many parents are fully aware of the importance of suitable food for the minds of their children. If all would do what they might, very little would be required of the Teacher. But in how many homes do we find one dollar spent for the improvement of the mind, to every hundred spent for physical comfort and luxuries! Many houses elegantly furnished in other respects have so few books that not even a shelf is required for their accommodation, and if you were to look at those on the parlor table you would find that most of them were gifts from sympathizing friends.

In other homes, there is no lack of a class of books, very fashionable indeed, and to a certain extent useful; but the reading of these alone, will not make intellectually strong men and women. They should be used as delicacies, of which too many would vitiate the appetite. While children may have these, they *must* have others, and though a good library is beyond the reach of many families, few are so poor as to be unable to take good Newspapers and Magazines, the reading of which would, in part at least, supply the want.

I have said a great deal about the duty of parents, because I think it lies at the root of the matter. If children are surrounded by books they will soon learn to use them, especially if the conversation in a cultivated home-circle shows them what is to be gained by reading. I have not much sympathy with what are called children's books. "Pilgrims' Progress," "Arabian-nights," "Gulliver's Travels," and "Uncle Tom's Cabin," were written for adults; yet children delight in them. Augusta Webster, says:—"It is not only the grown up story-books that make good children's books. The child allowed the run of the library, finds for itself plenty of others. Often its choice is a surprise and puzzle to its elders, who find it calling one book amusing, and another too difficult and dull when they shall have reversed the description." I asked some of my pupils to give me a list of the books they had read; a little girl of ten gave, among others, the following books:—"Barnaby Rudge" and "Little Dorrit," by Dickens; "Ivanhoe," "Pilgrim's Progress," "A Journey into the Interior of the Earth," "Martyr Heroes of the Scottish Covenant," "The Fur-traders," "The World of Ice." Another of the same "mature" age gave "Byron," "Canterbury Tales," "Great Inventions," "Prince Albert," and "Southey's Life of Nelson." None of these would be classed as children's books, and though children may not be able to explain all that they read, they understand more than they get credit for.

But while some of our pupils read a great deal, others read but little; and it is on these that the influence of the teacher should be brought to bear. It is not necessary to ask them what books they have read, to find out who they are. They show their want of culture in their language, in the grammar lesson, in the composition exercise, in the literature lesson, and in their lack of general information and want of what Saxe says the Germans call "Mutterwitz," and the Yankees call "Gumption."

The opinion should be cultivated in the school that not to know something of the best writings in our language is to be very ignorant and to lose much pleasure. For this purpose the reading lessons furnish good opportunities, if the interest of pupils be awakened by judicious questioning and thorough analysis. The interest would be greater if instead of brief extracts, our advanced readers contained some of the best of the shorter poems complete. Time is wasted by scattering our work over too wide a field. Occasionally we might lend books to our pupils, especially to those not inclined to read, and by selecting something suited to their tastes and talking over the contents of the books as we have opportunities, we may stimulate even the careless and help those who have no encouragement at home. During the first three years of my teaching, I happened to have the disposal of the surplus papers of a Sabbath School, and made use of them in my school, and to see the eagerness with which they were received used to make me indulge in wild visions of a child's paper, published free of cost to schools by the Education Department. Perhaps the dream might be realized now that the N. P. is giving such prosperity to our country.

As Teachers are often the leading spirits in educational matters in rural sections more might be done in establishing School Libraries. Through the praiseworthy efforts of my predecessor, my pupils have access to a large and well selected Library. To the earnest teacher many ways of fostering this love of reading will suggest themselves, and though the majority of our pupils may not have the benefit of a lengthened school course, if the habit of general reading be thoroughly established, a foundation is laid upon which a liberal education will be built. Let us then, labor diligently to secure this end, and great will be our reward.

HEALTH DEPARTMENT.

Editor: A. Hamilton, M. A., M. D., Port Hope, Ont.

THE SCHOLAR'S EYE.

III.

SHORTSIGHTEDNESS.

Preliminary Optical Experiment.
Analogue of do. in the Eye.
Application of do. to Myopia.
Use of Concave Glasses.
Nature of Shortsightedness.
Its mode of production and increase.
Period of life when it prevails.
Statistics.

Before entering into an explanation of the defects of refraction in the human eye, it is necessary to premise the following optical experiment:—Take a convex lens and place it in a hole in the shutter of a darkened room. If the rays of the sun be allowed to pass through it they will be caused to converge by the lens to form an exceedingly bright and rather warm spot, to be received upon a movable curtain. This spot or point is called the focus (Latin, *focus*, fire-place) of the lens. If the experiment be performed at night, and a lamp or some luminous point be substituted for the sun, the same bright point will be observed. The position of the point will depend upon the distance of the lamp in front of the lens. As the lamp approaches the lens the focus recedes. The flame of the lamp must move in the right line, called the axis of the lens. If the lens chosen be that called a 3-inch one, the sun's rays will focus at 3 inches behind the centre of the lens. This is called its *principal focus*. The principal focus of a lens is the focus for rays that are parallel, that is, emitted by a light (as the sun) at a (comparatively) infinite distance. As our lamp approaches our 3-inch lens, the focus recedes through 3, 3½, 4, 5, 6 inches until, when the light is at 3-inches from the lens, or at the principal focus in front, our moving bright focus is at an infinite distance, or the rays leave the lens parallel. If our lamp be 20 or more feet distant, its rays will be sufficiently near parallel for all practical purposes. Removing it to such a distance we observe the bright point, or focus, to be just a trifle beyond 3 inches from the centre of the lens. If, now, we place another convex lens between the lamp and the first lens, the focus of the two will be nearer or less than 3 inches distant, depending upon the converging power of the added lens. If we substitute a concave lens for the added convex one, the bright focal point has removed beyond 3 inches, its distance beyond being variable at will, according to the greater or less concavity of the added lens. Let the curtain on which we receive the bright spot be fixed at any specified distance behind our first lens. If fixed at 3 inches, the focus comes upon it without a second lens being added. If, however, it be placed at a distance greater than 3 inches, we can still focus on it by either moving the lamp nearer the lens or leaving the lamp stationary and inserting a concave lens between the lamp and convex lens, the power of the concave lens to vary with the varying distance of the curtain beyond 3 inches. If the curtain be at less than 3 inches behind the lens, we can in like manner focus on it by inserting another *convex* lens before our first and stationary lens. Throughout the experiment we assume the reader to be familiar with the following elementary optical facts :—

(1). A convex lens makes rays converge.

(2). A concave lens makes rays diverge.

(3). When a convex and concave are combined, the emitted rays may converge or diverge according to which predominates in power.

Now what we have been verifying by our experiment is going on in the eye all the time. The curtain of the eye is the retina, a thin membrane, concave forwards, an expansion of the optic nerve, which receives the images and transmits them to the brain. The lamp is any luminous or illuminated object at which we look. Our 3-inch lens is the crystalline lens of the anatomist. The bright spot on the curtain is the image of the object on the retina. The superadded glass between the object and the lens is the glass of a pair of spectacles. The walls of our darkened room are the coats of the eye which exclude light. In the eye there are besides two wonderful mechanisms not found in our experiment, first, the iris, a movable curtain, placed in front of the lens, with a hole in it, the pupil, of size varying chiefly according to the varying necessities for greater or less light; second, a small set of muscles, called the apparatus of accommodation, which causes the lens to become more or less convex, according to varying necessities of distance in vision. If accommodation were unlimited there would be no necessity for a glass. This accommodation is often much too limited in power, and it becomes the duty of the oculist to give such advice as shall supplement what accommodation there may be.

What is Myopia or Shortsightedness? It is a *disease* (rather than defect) of the eye, manifested by distant objects being seen with distinctness less than normal, and by the eye-ball being preternaturally long, (like a prolate spheroid, egg-shaped). This indicates only the chief manifestation and chief anatomical change. The consequence of this elongation is that the retina is too far back to receive images which are formed in front of it. Objects brought nearer than common to the eye, to the end of the nose in extreme cases, are seen with normal distinctness. This is because when the object is near, the rays are given off and enter the eye diverging, and are brought to focus farther back than parallel or rays from a distance, and so form a distinct image on the retina. The focal distance of the crystalline lens and its adjunct refracting humors is a little less than an inch. In shortsightedness the diameter of the eye from front to rear may be an inch or even more in its higher degrees. If a concave glass of sufficient power be placed in front of the eye, the image will be thrown farther back than without it, and so comes upon the retina exactly. Furthermore, the image is now distinct. The glass delivers the rays to the eye, slightly diverging according to principle (2) already postulated. The myopic individual finds instinctively that when rays are slightly divergent he sees better, and to get them so brings the book or other object nearer than usual. Is this instinct wrong? No. Follow gentle Mother Nature—allow it. But a distant object, as a blackboard, cannot be brought near, and it is troublesome to have the pupil go to the blackboard, as well as wasteful of the time of the whole class for this one defective individual. He should use, temporarily or constantly, a suitable glass, which shall do the work required, viz: deliver rays divergent to the eye, and save it from the worry of blurred images. Is this approved by multiplied experience? Yes, in the light of explanations given in the beginning of this article. This is why somewhat full explanation has been given of the optical part of the subject. I might have stated the subject dogmatically. I have preferred to use the reader's reason, furnishing him with data to come to an independent conclusion. Many pupils have an antipathy or distaste for glasses. They should get over it. Many parents object and ask if once resorting to glasses does not require a constant resort to them. You can explain to them the necessity for delivering the rays to the eye in a diverging manner. Can it be injurious to do so? No, no more than to deliver food properly cooked and masticated to the stomach. Will they not always require the glass? Very likely, and they will require their food properly cooked and masticated too. If the glass be not worn the eye will be injured. If our coughing patient will not wear an overcoat in inclement weather, we are not surprised when he turns up some months later with more serious lung trouble and destruction of delicate air vesicles. Should he have worn an overcoat? Yes. Will it be needful for him often to resort to it in future? Quite likely. If he does not wear such he must take ultimate results on his own shoulders. He can do as he pleases; it is a free country. He can bolt his food too, if he likes, and furnish more work for the doctors.

The Myopia of the scholar's eye is commonly *progressive*, *i. e.*, its degree becomes higher and higher, going from bad to worse. What influences favor its increase? Unfortunately, just such influence as pertain to school life. Four of the six muscles which move the eyeball run parallel to its antero-posterior diameter. Now, by great use of the eye, these and its other anatomical parts are brought into more vigorous and frequent use. The action of the muscles is to compress and so elongate an eye already too elongated. Hence, school life is highly prejudicial to shortsighted children. Space does not permit a more full exposition of this and other more important points. It is enough if the directions given are based upon rational and tried grounds. Rational medicine, with its long history and vast accumulation of facts, often gives no uncertain sound on this and other matters, to which no attention is paid; the pretentious charlatan getting too often the confidence better reposed elsewhere.

Says Dr. Loring, of New York:* "The great period for the development of Myopia, that is, for its *beginning*, is from the tenth to the fifteenth year, just at the time when the body is developing most rapidly. Near-sightedness is essentially a disease of childhood, or at the latest of adolescent life. Donders declares that he never

* Report of Conn. Board of Ed., 1878.

has seen a case of Myopia *originate* after the twentieth year. Myopia is especially prevalent among the so-called cultivated classes. Yet students do not use their eyes for more hours a day and on finer objects than jewellers, engravers, draughtsmen, seamstresses, type-setters, and many others who engage in long continued work on small objects. These occupations do not show any tendency to nearsightedness, while the professional and literary callings do. The principal reason why the members of mechanical arts show less Myopia than those of studious and literary occupations, is not because they use their eyes less, but the application of the eye occurs at a different time of life and under entirely different conditions."

This tendency of school life, not only to increase existing shortsightedness, but to develop it, can be strikingly shown by extensive statistics. Space permits me only to quote* the results in one case, the others varying somewhat, but favoring the same general conclusion. "In 1871, Dr. Erisman published the results of his investigations of the condition of the eyes of 4,358 scholars, at various educational establishments in St. Petersburg. The pupils were aged from eight to twenty. Taking the classes in order, the fifth being the most advanced, the following results were obtained:—

CLASS.	PERCENTAGE OF MYOPIA
Preparatory:	13.6
I.	15.8
II.	22.4
III.	30.7
IV.	38.4
V.	41.3

* Report of Conn. Board of Ed., 1878.

In Germany it is a matter of observation that shortsightedness is more common than with us. Yet the statistics of Dr. Cheatham, obtained by examination of eyes of students in the New York College, show that 29 per cent. are so in the Introductory class, and 40 per cent. are so in the Freshmen class. These percentages include both high and low degress of it. As stated in last month's MAGAZINE, great complaint is seldom made until vision for distance is reduced one-half.

CRAMMING.

Would that educators knew that "*Savoir par cœur n'est pas Savoir*," and that they would act accordingly. Bacon, in the first axiom of the *Novum Organon*, says, "Man, the servant and interpreter of Nature, understands and reduces to practice just so much of Nature's laws as he has actually experienced; more he can neither know nor achieve." Accepting these opinions, it follows that much of our present educational system must miss its aim. After all, the most of schools, yes and colleges, teach is, not to know, but to know where and to be able to find recorded facts. The teacher who supposes his pupil *knows* what he can recite creditably does not himself know what he is doing, At best he is insisting on certain specified knowledge being well indexed. If, in accomplishing this object, he injures, and that perhaps irreparably, the psychological and physiological development of the pupil, has he not done more harm than good? In these days the welfare of the body is too much subordinated to the training of the intellect. The subject of cramming deservedly received much attention and marked condemnation at the recent session of the Canada Medical Association at Ottawa. It is believed to be an evil, and most prevalent in our best schools. In all fairness, however, it must be remembered that the teacher is not wholly at fault. He is but a principal wheel in the educational machine which is grinding many young lives into semi-imbecility. The chief fault lies in our high pressure school system. One of the chief evils of that is *too much teaching is done in classes.* The teacher cannot take sufficient cognizance of individuals who need special help, where the class is large. Now he urges the indolent; the effect of the urging falls upon the mentally active, but it may be physically weak. Now he coaxes by rewards and distinctions; he influences those most who need it least. If the sluggish and phlegmatic do not respond, he applies a stronger stimulus; the response comes feebly from those intended to be influenced, but tells with injurious effect in other parts of the line. It is very easy for worthy doctors in council at Ottawa to utter diatribes against cramming; it is not so easy to prescribe and especially to apply the remedy just where it is required. We believe that smaller classes, with a general recognition both by the people and the educators as a class, of the paramount importance of having all the *bodily* functions in good working order, as a basis on which to build, is the remedy. Let teachers foster great intellectual advancement in those pupils only who have suitable mental and bodily material therefor.

EVILS OF THE KINDERGARTEN.

The annual meeting of the American Social Science Association was held at Saratoga in September. One of the subjects most fully discussed was that of the education of children and women. The subject was opened with a paper by Col. T. W. Higginson on the Kindergarten system. There is, he said, danger of overstimulating the brain in a manner injurious to and incompatible with child-life. This arises in a measure from the fact that the disposition of the child's time is made by persons of mature age and strength, who can seldom rightly gauge and estimate the importance of frequent changes and variety of occupations, and the place that absolute idleness and repose hold in the healthy development of all children. As says Margaret Fuller of the forcing process insisted upon by her father in her own education, "Children should not cull the fruits of reflection and observation early, but expand in the sunshine, and let thoughts come to them." The child, when left largely to its own resources, often defends itself from a tension of mind at once premature and injurious. There is the danger of overstimulating the nervous system, by which the digestion becomes so much weakened as to seriously interfere with the proper nourishment of the child's system, a danger the more perilous as teacher is not likely to know of such a result until the family physician is called upon for counsel when the difficulty has become a serious matter. And there is the danger of straining the eyes; a trouble whose symptoms are unknown to the pupil, and often unsuspected by the teacher. The sight of children in some instances has been thus permanently impaired.

If this be true of the Kindergarten system, it is, *a fortiori*, true of our ordinary school system.

MATHEMATICS.

Solutions to Examination Papers in last number.

PASS.

1. The rates are as 91 : 81.

3. Since every £90 invested produces £1½ income every half year, *i.e.*, every £60 invested produces £1, therefore the second income is greater than the first by one-sixtieth of the first, or one-sixty first of the second; hence the difference required is equal to £457 10s. ÷ 61, which is equal to £7 10s.

4. (1).
$$\frac{acx^2+adx-bcx-bd}{a^2x^2-b^2}$$
$$=\frac{cx(ax-b)+d(ax-b)}{a^2x^2-b^2}$$
$$=\frac{(cx+d)(ax-b)}{(ax+b)(ax-b)}$$
$$=\frac{cx+d}{ax+b}$$

(2.)
$$\frac{x^2+3x+2}{x^2+2x+1}\times\frac{x^2+5x+4}{x^2+7x+12}$$
$$=\frac{(x+1)(x+2)(x+1)(x+4)}{(x+1)(x+1)(x+3)(x+4)}$$
$$=\frac{x+2}{x+3}$$

(3). $\left(\frac{y}{x}\right)^{\frac{1}{4}}$

5. (1).

	1	+0	+0	+0	−1	+10	−10
3		3	9	15	15		
−4			−4	−12	−20	−20	
2				2	6	10	10
	1	+3	+5	+5			

∴ x^3+3x^2+5x+5 is the quotient required.

(2).

2	6	−23	+0	+22	−16
5		15	−20	10	
8			24	−32	16
	3	−4	+2		

∴ $3x^2-4x+2$ is quot. req'd.

6. (1). $(1+x)^{\frac{1}{3}}+(1-x)^{\frac{1}{3}}=2^{\frac{1}{3}}$

Raise each side to the third power; thus

$$2+3\,(1-x^2)^{\frac{1}{3}}\times 2^{\frac{1}{3}}=2$$

whence $x=\pm 1$.

(2) $x=144$, $y=216$.

(3). Divide the first equation through by $9yz$, the second by $8zx$, &c., and we have

$$\frac{1}{y}+\frac{1}{z}=\frac{7}{9} \qquad (a)$$
$$\frac{1}{z}+\frac{1}{x}=\frac{1}{8} \qquad (b)$$
$$\frac{1}{x}+\frac{1}{y}=\frac{1}{3} \qquad (c)$$

Add (*a*) and (*b*) and subtract (*c*)

$$\therefore\ \frac{2}{z}=\frac{7}{9}+\frac{1}{8}-\frac{1}{3}=\frac{41}{72}$$
$$\therefore\ z=\frac{144}{41}$$

Similarly $x=-\frac{144}{23}$, $y=\frac{144}{71}$

7. (1). 8 hrs. after the second messenger starts, and after going 38 miles,

(2).

Let x = rate of walking up hill, in miles per hr.
" y = " " on level, " "
" z = " " down hill, " "

$\therefore\ \frac{5}{x}$ = No. hrs. req'd to go 5 m. up hill.

$\frac{4}{y}$ = " " " " 4 m. on level.

$\frac{6}{z}$ = " " " " 6 m. down hill.

$$\therefore \frac{5}{x} + \frac{4}{y} + \frac{6}{z} = 3\frac{52}{60} \quad (a)$$

$$\frac{6}{x} + \frac{4}{y} + \frac{5}{z} = 4 \quad (b)$$

$$\frac{5}{x} + \frac{5}{y} + \frac{5}{z} = 3\frac{55}{60} \quad (c)$$

Multiply (a) by 5, (b) by -10, (c) by 4, and add these results, and we have $x = 3$. Then $y = 4$, $z = 5$.

8. (i)

$$(x^2 - 2x + 5) + 6\sqrt{x^2 - 2x + 5} = 16$$

$$\therefore \sqrt{x^2 - 2x + 5} = 3 \pm 5$$

$$\therefore x^2 - 2x + 5 = 64 \text{ or } 4$$

$$\therefore x = 1, 1, 1 \pm \sqrt{60}$$

(ii) $x^4 + y^4 = 257 \quad (a)$

$x + y = 5 \quad (b)$

substitute $m + n$ for x

and $m - n$ for y

Then (a) becomes

$$2m^4 + 2n^4 + 12m^2n^2 = 257 \quad (c)$$

and (b) $2m = 5$

substituting for m in (c) we get

$$16n^4 + 600n^2 = 1431$$

$$\text{whence } n = \pm\frac{3}{2}, \pm\frac{1}{2}\sqrt{-159}$$

$$\therefore x = m + n = 4, \text{\&c.}$$

$$y = m - n = 1, \text{\&c.}$$

(iii) $a^x b^y c^z = l$

$a^y b^z c^x = m$

$a^z b^x c^y = n$

whence

$$\log. a \cdot x + \log. b \cdot y + \log. c \cdot z = \log. l$$

$$\log. c \cdot x + \log. a \cdot y + \log. b \cdot z = \log. m$$

$$\log. b \cdot x + \log. c \cdot y + \log. a \cdot z = \log. n$$

$$\text{whence } x = \frac{l(bc - a^2) + m(ab - c^2) + n(ca - b^2)}{3abc - a^3 - b^3 - c^3}$$

writing a for $\log. a$, &c.

11. Take O, the centre, and join OP, OQ. Let the tangents at P, Q meet at K. Then OPRQ is a quadrilateral, having the angles at P, Q right angles; therefore the angles POQ, PRQ are together equal to two rt. angles; hence the angle POQ is equal QRK (formed by producing PR to K).

ALGEBRA.

1. $$a^{-2} - 2 + a^2 = \frac{1 - 2a^2 + a^4}{a^2} \text{ \&c.}$$

$\therefore$ the expression becomes

$$\frac{\dfrac{1 - 2a^2 + a^4}{a^2} \times \dfrac{1 - 2a + a^2}{a} \times a^2}{1 - a^4 - 2a + 2a^3}$$

$$= \frac{(1 - a^2)^2(1 - a)^2}{a(1 - a^2)(1 + a^2 - 2a)}$$

$$= \frac{1 - a^2}{a} = a^{-1} - a$$

2. $$\frac{1 + x}{1 - x}(1 + x + 2x^2 + x^3)$$

3. The expression when multiplied out becomes

$$2s^3 - (a + b + c)s^2 + abc$$

$$= 2s^3 - (2s)s^2 + abc$$

$$= abc$$

4. $x + p + q$ is a measure of $x^2 + px + p^2$

if $(p + q)^2 - p(p + q) + p^2 = 0$

that is if $p^2 + pq + q^2 = 0 \quad (a)$

Similarly $x + p + q$ can be shewn to be a measure of $x^2 + qx + q^2$

But (a) is also the condition that $x - p$ may be a factor of $x^2 + qx + q^2$, and that $x - q$ may be a factor of $x^2 + px + p^2$

$$\therefore x^2 + px + p^2 = (x - q)(x + p + q)$$

and $x^2 + qx + q^2 = (x - p)(x + p + q)$

and the L. C. M. of these is

$$= (x - p)(x - q)(x + p + q)$$

$$= (x - p)(x^2 + px + p^2)$$

$$= x^3 - p^3$$

5. Book work.

6. (1) $$\frac{a}{x - a} + \frac{b}{x - b} + \frac{c}{x - c}$$

$$= \frac{abc}{(x - a)(x - b)(x - c)}$$

becomes $(a + b + c)x^2$

$- 2(ab + bc + ca)x + 2abc = 0$

$$\therefore x = \frac{ab + bc + ca \pm \sqrt{a^2b^2 + b^2c^2 + c^2a^2}}{a + b + c}$$

(2) $\sqrt{x^2+3x-10}+x+5=\sqrt{x+5}$

$\sqrt{(x+5)(x-2)}+x+5=\sqrt{x+5}$

divide thro' by $\sqrt{x+5}$ $\therefore x=-5$

$\therefore \sqrt{x-2}+\sqrt{x+5}=1$

whence $x=11$

which satisfies the equation when the negative root of $x^2+3x-10$ is taken.

(3) $xz+yz=xy$

$x^2(5z+y)=5yz$

$10z-6x^2=10x^2z$

$$\therefore \frac{1}{x}+\frac{1}{y}=\frac{1}{z} \quad (a)$$

$$\frac{5}{y}+\frac{1}{z}=\frac{5}{x^2} \quad (b)$$

$$\frac{10}{x^2}-\frac{6}{z}=10 \quad (c)$$

multiply (a) by 5 and subtract from (b)

$$\therefore \frac{6}{z}=\frac{5}{x}+\frac{5}{x^2}$$

$$\text{but } \frac{6}{z}=\frac{10}{x^2}-10 \text{ from } (c)$$

$$\therefore \frac{5}{x}=\frac{5}{x}+10$$

$$\therefore x=\frac{1}{2} \text{ or } -1.$$

If $x=\frac{1}{2}$ $\therefore y=\frac{1}{3}$ and $z=\frac{1}{5}$, &c.

7. $x^4-10x^2+1=0$

$\therefore x^2=5\pm\sqrt{24}=5\pm2\sqrt{6}$

$\therefore x=\sqrt{5\pm2\sqrt{6}}=\sqrt{3}\pm\sqrt{2}$

$\therefore \frac{1}{x}=\sqrt{3}\mp\sqrt{2}$

$=1.7320\mp1.4142$

$=.317$ or 2.146.

8. Let d be the com. dif. and p the number of terms.

$$\therefore \frac{m}{n}+md=(m+1)\text{th term}=1$$

$$\therefore d=\frac{n-m}{mn}$$

$$\text{and } \frac{m}{n}+(p-1)d=\text{last term}=\frac{n}{m}$$

$$\therefore p=m+n+1$$

and sum of series $=\left(\frac{m}{n}+\frac{n}{m}\right)\times\frac{1}{2}p$

$$=\frac{m^2+n^2}{mn}\cdot\frac{m+n+1}{2}$$

9. Series $=\sqrt{3}\left(1+\frac{1}{\sqrt{2}}+\frac{1}{2}+\&c.\right)$

$\therefore s=\sqrt{3}(2+\sqrt{2})(1-2^{-n})$

and sum to infinity $=\sqrt{3}(2+\sqrt{2})$

UNIVERSITY OF TORONTO.—SENIOR MATRICULATION, SEPTEMBER, 1880.

ARITHMETIC AND ALGEBRA.

1. Prove the following :—

(*a*) When the three right-hand digits of a number are divisible by 8, the whole number is divisible by 8.

(*b*) When, in a number, the sum of the digits standing in the even places is equal to the sum of those standing in the odd places, the number is divisible by 11.

2. Change 592835 from the decimal to the duodenary scale, shewing clearly the reasons for each step.

3. Prove the rule for reducing a mixed circulating decimal to a vulgar fraction.

Add together :

$7.\dot{4}\dot{2}7$, $9.\dot{1}23\dot{4}$, $17.29\dot{8}764\dot{3}$, $18.\dot{6}\dot{7}$,

and give your answer in a decimal form.

4. Extract the square root of 79,792,266,297,612.001; and the cube root of 62,712,728,317.

5. State the ordinary "Index Laws," and deduce the value of a^0.

6. Divide, according to Horner's Method, $x^9+x^8+x^7+2x^6-x^4-x^2-2x-1$ by x^4+x^3+x+1.

7. When $f(x)$ is divided by $x-a$, shew that remainder is $f(a)$.

Ex. $a^3(b-c)+b^3(c-a)+c^3(a-b)$ is exactly divisible by $a+b+c$.

8. Prove the rule for finding the L. C. M. of two or more quantities. Find the L. C. M. of

$(x + y)(x^2 + y^2) + 2xy - 1$, and

$(x + y - 2)(x + y)^2 + 2(1 - xy)(x + y) + 2xy - 1$.

9. Solve the equations :

(i) $ax^2 + bx + c = 0$. (ii) $x^3 - 2x - 4 = 0$.

(iii) $\left.\begin{aligned} x^2 + xy + y^2 &= a^2 \\ x + \sqrt{xy} + y &= b \end{aligned}\right\}$

(iv) $\left.\begin{aligned} x^p y^q &= a^p b^q c \\ x^q y^p &= a^p b^q d \end{aligned}\right\}$

10. Find the sum of n terms of a series in Geometric Progression.

Sum to $\overline{2p + 1}$ terms :

$$\frac{1}{a}\sqrt{b} - \frac{1}{a}\sqrt{a} + \frac{1}{b}\sqrt{b} - \frac{1}{b}\sqrt{a} + \ldots$$

11. If $(b - c)x + (c - a)y + (a - b)z = 0$,

shew that $\dfrac{b-c}{cy-bz}$ = anal. = anal.

EUCLID.

1. Define the terms *plane rectilineal angle, rectangle, gnomon, circle, segment of a circle.*

If two triangles have two sides of the one equal to two sides of the other, each to each, and have likewise the angles contained by those sides equal to one another, their bases, or third sides, shall be equal; and the two triangles shall be equal ; and their other angles shall be equal, each to each, namely, those to which the equal sides are opposite.

2. If two lines bisect the angles at the base of a triangle, the line joining their point of intersection and the vertex bisects the vertical angle.

3. The complements of the parallelograms which are about the diagonal of any parallelogram are equal to one another.

4. In every triangle, the square of the side subtending any of the acute angles is less than the squares of the sides containing that angle, by twice the rectangle contained by either of these sides, and the straight line intercepted between the perpendicular let fall upon it from the opposite angle, and the acute angle.

5. If any point be taken in the diameter of a circle which is not the centre, of all the straight lines which can be drawn from it to the circumference, the greatest is that in which the centre is, and the other part of that diameter is the least ; and, of any others, that which is nearer to the line which passes through the centre is always greater than one more remote. And from the same point there can be drawn only two straight lines that are equal to one another, one upon each side of the diameter.

6. Draw a straight line from a given point, either without or in the circumference, which shall be a tangent to a given circle.

7. About a given circle, describe a triangle equiangular to a given triangle.

8. If a straight line be drawn parallel to one of the sides of a triangle, it must cut the other sides, or those sides produced, proportionally.

9. In right angled triangles, the rectilineal figure described upon the side opposite to the right angle is equal to the similar and similarly described figures upon the sides containing the right angle.

10. Describe a triangle, having given the base, area, and vertical angle.

11. ACB is a triangle right angled at C; AD bisects the angle BAC and AE bisects the opposite side. Prove that DE is to CE in the duplicate ratio of CD to CA.

12. ABC is a triangle in the circle ABC; the arc BC is bisected in D; prove that $AD^2 = BD^2 + AC \cdot AB$.

13. If three lines be in continued proportion, the first is to the third as the square of the difference between the first and second, to the square of the difference between the second and third.

14. Two semi-circles AEB, AFD are drawn on the sides AB, AD of the rectangle $ABCD$;

EF is the common tangent; shew that twice the square on *EF* is equal to the rectangle *ABCD*.

14. Draw a straight line, so that the part of it intercepted between one side of a given isosceles triangle and the other side produced, shall be equal to a given line, and be bisected by the base.

FIRST-CLASS TEACHERS.—GRADE C.

ALGEBRA—JULY, 1880.

1. If in $ax^2+2bxy+cy^2$, $ku+lv$ be substituted for x and $mu+nv$ for y, the result takes the form

$$Au^2+2Buv+Cv^2$$

find the value of $(B^2-AC)\div(b^2-ac)$ in terms of k, l, m, n.

2. Resolve into factors

$$a(b-c)^3+b(c-a)^3+c(a-b)^3.$$

Prove that

$$\frac{Au^3+Bv^3+Cw^3}{uvw}=\frac{Ax^3+By^3+Cz^3}{xyz}$$

if $u=x(By^3-Cz^3)$
$v=y(Cz^3-Ax^3)$
$w=z(Ax^3-By^3)$

3. Extract the square root of

$$(a-b)^2(b-c)^2+(b-c)^2(c-a)^2+(c-a)^2(a-b)^2$$

and the cube root of

$$4\{(a-b)^6+(b-c)^6+(c-a)^6-3(a-b)^2(b-c)^2(c-a)^2\}$$

4. Eliminate x, y, z from

$$ax+by+cz=1,\ \frac{a}{x}=\frac{b}{y}=\frac{c}{z},$$

$$K(x^2+y^2+z^2)+2(lx+my+nz)+h=0$$

5. Simplify $\dfrac{a\sqrt{b}+b\sqrt{a}}{\sqrt{a}+\sqrt{b}}$

$$\{\sqrt{(4+3i)}+\sqrt{(4-3i)}\}^2$$

and $\left(\dfrac{-1+i\sqrt{3}}{2}\right)^2+\dfrac{-1+i\sqrt{3}}{2}+1$

in which i is $\sqrt{-1}$.

6. Given the first term, the common difference, and the number of terms in an arithmetical progression; find (i) the sum of the terms, (ii) the sum of the squares of the terms.

7. Solve the equations

(i) $(a-x)^3=(x-b)^3$

(ii) $ax+by=\dfrac{a}{x}+\dfrac{b}{y}=1$

(iii) $x(y+z^{-1})=a$
$y(z+x^{-1})=b$
$z(x+y^{-1})=c$

8. What value (other than 1) must be given to q, that one of the roots of $x^2-2x+q=0$ may be the square of the other?

If a, b, c are the roots of $x^3-px^2+qx-r=0$, express

$$\frac{2a^2b^2+2b^2c^2+2c^2a^2-a^4-b^4-c^4}{2ab+2bc+2ca-a^2-b^2-c^2}$$

in terms of p, q, r.

9. A vessel makes two runs on a measured mile; one with the tide in m minutes and the other against the tide in n minutes. Find the speed of the vessel through the water, and the rate the tide was running at, assuming both to be uniform.

10. Five points A, B, C, O and P lie on a right line. The distances of A, B and C, measured from the point O, are a, b, c; their distances measured from the point P are x, y, and z. Prove that whatever be the position of the points O and P,

$$x^2(b-c)+y^2(c-a)+z^2(a-b)$$
$$+(a-b)(b-c)(c-a)=0.$$

SOLUTIONS.

(*Arithmetic—Second Class, September and October.*)

1.—Disct. 20=per cent. of face, or $22\frac{1}{2}$ per cent. of proceeds; ∴ proceeds $= \frac{20}{22\frac{1}{2}} = \frac{8}{9}$ of face, and discount $= \frac{1}{9}$ of face $= 11\frac{1}{9}$ per cent.: ∴ time $= \frac{11\frac{1}{9}}{20} = \frac{5}{9}$ yr. ∴ 200 dys.—Ans.

2.—P. W. of \$1 due in 4, 9, 12, 20 mon. = \$.98361, \$.96385, \$.95238 and \$.92308 respectively; therefore sum = \$3.82292 = P. W. of \$4; ∴ \$3.82292 : \$750 :: \$4 : \$784.74—Ans.

3.—Interest of \$1 for 63 days = \$.021 ∴ discount $= \frac{21}{1021}$, ∴ loss $= \frac{441}{1021000}$. ∴ ace $= \$4\,80 \div \frac{441}{1021000} = \$11112.93$.—Ans.

4.—P. W. of \$200 for 1, 2, 3, 4, 5 mos. at 9 per cent. = \$198.511; \$197.044; \$185.599; \$194.175; \$192.771; ∴ sum=\$978.10. Ans.

5.—\$1 Face of check cost 55c.; I received \$1 ÷ .60 = \$1⅔ bonds; 7 per cent. of \$1⅔ = 11⅔c. = income on 55c. = $21\frac{7}{33}$ per ct.

6.—Since comp. amt. of \$1 = \$1 + rate raised to power indicated by number of payments ∴ \$19487.171 ÷ \$13310 = comp. amount of \$1 for 4 years = 1.4641 ∴ $\sqrt[4]{1.4641}$ = amt. for 1 year = \$1.1 ∴ rate 10 per cent. Again \$13310 = P × $(1.1)^3$ ∴ P = \$10000. Ans.

7.—$2\frac{1}{2}$ per cent. of \$1500 = \$37 50 ∴ amt. received = \$1462.50; ∴ \$1462.50 ÷ 1.15 = \$1271 739, cost and interest for 3 months ∴ cost = P. W. of \$1271.739 for 3 months at cent. = \$1252.94 Ans.

8.—69 per ct. = ¾ of 92 per cent ∴ rec. ¾ as much stock @ 92 as @ 69; 7 per cent. of ¾ = 5¼ per cent. on whole; ∴ gain ¼ per cent. per annum on \$5200, = \$13. ∴ \$13 ÷ .06 = \$216⅔ cash gain. Ans.

9.—\$49 = 4900 cents ∴ $\sqrt{4900} = 70$.—Ans.

10.—Sales, without credit or debts = $119\frac{1}{2}$ per cent. of cost = P. W. of sales at 6 months. ∴ $119\frac{1}{2}$ per cent. × 1.03 = 123.085 per cent. of cost, without debts; ∴ 123.085 ÷ .95 = 129.56 per cent. of cost to cover all conditions, ∴ 29.56 + per cent. marked price.—Ans.

SOLUTIONS TO PROBLEMS FROM CORRESPONDENTS.

Under this heading we shall give concise solutions to questions sent in by subscribers.

ABC is an equilat. triangle. D is taken in AB so that AD is ⅓ AB; E in BC so that BE is ⅓ BC and F similarly in CA. AE, BF, CD are joined, CD, AE meeting in G; AE, BF in H; BF, CD in K. It is required to show that GHK is an equilat. triangle, and to ascertain what relation it bears to the whole tri. ABC.

Because EB, BA are eq DA, AC ea. to ea. and ang. CBA eq. ang. DAC ∴ the base EA eq. DC and ang. BEA eq. ADC and BAE eq ACD. In like manner the triangle CFB can be shown to be eq. in all respects to either of these. Then in the triangles ADG, AEB bec. ang. ADG eq. AEB and DAG is com. ∴ AGD eq. ABE. eq. ⅔ rt, ang. Hence KGH is ⅔ rt. ang. and similarly for angs. at K, H hence GHK is an equilateral triangle.

Again, it is evident that the triangles CFK, ADG, BEH, are similar and eq. as are also the figures FKGA, DGHB, EHKC. Also that each of the triangles ABE, &c. is $\frac{1}{3}$ ABC. Denote ea. of the tri. ADG by a, and each of the figures FKGA by b. Then bec. BCD eq. 2 ABE $\therefore a+2b+GHK=4a+2b \therefore GHK=3a$.

Also since ADG, AEB are sim. triangs., DG : GA as EB : BA $\therefore$ DG is $\frac{1}{2}$ AG. Through H draw HL parallel to AB meeting GK in L, then ADG, HLG are sim. $\therefore$ GL is $\frac{1}{3}$ GH eq. $\frac{1}{3}$ GK.$\therefore$LGH is $\frac{1}{3}$ GHK.$\therefore$LGH eq. DGA $\therefore$ AG eq. GH $\therefore$ GHB eq. GAB; but GAB eq, 3GAD $\therefore$ GDBH eq. 5ADG $\therefore$ ABC eq. 21 ADG eq. 7GHK.

2. The sides of a triangle ABC are 25, 30, 35 feet, on these sides external squares ACED, ABHK, BCFG are described: find the aggregate area of the squares described on the lines GH, KD, EF.

Produce EC to P draw FP perp. to EP, also draw BL perp. to AC. Then bec. ang. LCP eq. BCF, each being a rt. ang., from ea. take BCP $\therefore$ BCL eq, PCF and angs. at P, L are rt. angs. and BC eq. FC hence CP eq. CL.

Since $EF^2=EC^2+CF^2+2EC\cdot CP$

$=AC^2+CB^2+2AC\cdot CL$

But $2AC\cdot CL=AC^2+CB^2-AB^2$

$\therefore EF^2=2AC^2+2CB^2-AB^2$

Sim. $DK^2=2BA^2+2AC^2-BC^2$

and $HG^2=2CB^2+2BA^2-CA^2$

$\therefore EF^2+DK^2+HG^2=3(AB^2+BC^2+CA^2)$

$=3(35^2+30^2+25^2)$

$=8250.$

3. Find the contents of frustum of a cone, diameter of larger end being $2\frac{1}{2}$ inches, of smaller 1 inch, and depth 5 inches.

Complete the cone and let x be the height of the smaller cone, then $x+5$ is the whole ht. and $2\frac{1}{2}:1$ as $x+5:x \therefore x=3\frac{1}{3}$.

Then vol. of frustum = vol. of large cone — vol. of smaller

$=(2\frac{1}{2})^2\times\cdot7854\times\frac{1}{3}\times8\frac{1}{3}-1\times\cdot7854\times\frac{1}{3}\times3\frac{1}{3}$

$=12\cdot7627.$

4. Find the centre of gravity of a right-angled isosceles triangle and the squares described on the two equal sides.

Let CA, CB be the two eq. sides, draw CD perp. to AB, then the cen. gr. is evidently in the line CD. Then c. g. of the triangle is distant $\frac{1}{3}$ DC from line AB, and c. g. of each sq. is distant DC from AB. Let x = dist. of c. g. required from AB and let W be the wt. of ABC. Then taking moments above the line AB we have (each sq. being = 2ABC)

$$W\times\tfrac{1}{3}DC+2W\times DC+2W\times DC=5W\times x$$

$$\therefore x=\tfrac{13}{15}DC,$$

5. A sphere weighing 200 lbs. rests between two planes inclined to the horizon at angles 30° and 60°; find the pressure on the planes, (by moments.)

Draw a line ECD horizontal, also draw CB CA making angles 30° and 60° respectively with ED. Let the sphere touch the planes at A, B, let O be its centre. Join OA, OB, and draw OX cutting ED at rt. ang. Then the sphere is kept at rest by three forces, the reaction (P) of the plane at A in dir. AO reaction (Q) at at B in dir. BO. and its weight in dir. OX. Now, since these three forces produce equilibrium the sum of their moments about any point is zero. Take a point G in OB and draw GF perp. to OX; taking moments about G we have

$$P\times OG-200GF=O.$$

But $OG=2GF \therefore P=100$

Similarly Q can be shown $=100\sqrt{3}$

6. A carriage wheel whose weight is W and radius R rests upon a level road; show that the power F necessary to draw the wheel over an obstacle of height H is

$$W\frac{\sqrt{2RH-H^2}}{R-H}$$

Let A be the point where the wheel touches the road, B where it touches the obstacle, C its centre, join CA, CB and draw BD perp. to AC. Then CB=R, CD=R—H and hence

$$BD=\sqrt{\{R^2-(R-H)^2\}}=\sqrt{(2RH-H^2)}$$

Therefore taking moments about B we have

$$F\times(R-H)=W\times\sqrt{2RH-H^2}$$

$$\therefore F=W\frac{\sqrt{2RH-H^2}}{R-H}$$

7. A rigid rod, the weight of which is 10 lbs., acting at its middle point, moves at one end

about a hinge and is supported at the other end by a piece of string attached to a point vertically over the hinge, and at a distance from it equal to the length of the rod; find the tension in the string when the rod is horizontal.

Let A be at the hinge, B other end of rod, C other end of string, and let $AB=2l$, ∴ $AC=2l$ and $BC = 2l\sqrt{2}$, ∴ AD (perp. from A on BC) $= l\sqrt{2}$. Then, taking moments about B, we have

$$\text{tension} \times l\sqrt{2} = 10 \times l$$
$$\therefore \text{tension} = 5\sqrt{2}$$

8. A rod AB without weight can turn freely about a hinge at one end B; it is held in a horizontal position by a force of 50 lbs. which acts vertically downwards through its middle point and by a force P which acts at the end A in such a manner that the ang. BAP $= 30^\circ$; find P.

Draw BC perp. to AP, then if $AB = 2l$, BC will $= l$; then, taking moments about B we have

$$P \times l = 50 \times l$$
$$\therefore P = 50.$$

CHEMISTRY.

Give tests for Oxygen, Hydrogen and Nitrogen Gases, Nitric Acid, the Oxides of Nitrogen and Ammonia.

(*a*). If a glowing splint be plunged into a jar of Oxygen it will be ignited. Nitrous Oxide (N_2O) is the only other gas that will relight a glowing splint. These two gases O, and N_2O, may be distinguished by admitting Nitric Oxide into jars containing each. In N_2O no change will manifest itself; while in O red fumes will be formed.

(*b*). Introduce into a jar of Oxygen standing over Mercury, a solution of potash (one part solid potash in 4 of water). No change takes place. Now introduce an equal quantity of Solution of Pyrogallic Acid (one part acid and six of water). Agitate the mixture. It becomes intensely brown and the Oxygen is absorbed. When a burning taper is brought to the mouth of a jar containing Hydrogen the gas ignites and burns with a bluish flame. If the burning taper be plunged into the jar it is at once extinguished. If Oxygen and Hydrogen be brought together in a vessel and a light applied, an explosion ensues with the production of steam. If Hydrogen and Chlorine, mixed in a jar, be exposed to sunlight, they unite with an explosion.

Nitrogen, if admitted into a vessel containing Hydrogen, will unite with it on passing Electricity through the mixture. Animals die when brought into this gas (N), not because it is poisonous, but on account of the absence of Oxygen. A lighted taper is extinguished if plunged into this gas, and the gas does not ignite.

Nitric Acid, when pure, is a colorless transparent, corrosive fluid, but *usually* of a reddish color on account of the presence of some of the lower oxides of Nitrogen. It is a strong solvent of nearly all metals. If copper be brought into Nitric Acid in contact with the air, red fumes will be given off, and a bluish solution—Copper Nitrate, $Cu(NO_3)_2$ will remain. A more accurate, as well as a more delicate test for the presence of Nitric Acid, or any of the Nitrates, may be made by pouring on the liquid to be tested an equal volume of strong Sulphuric Acid (H_2SO_4) to ensure the presence of free Nitric Acid (HNO_3)—cool the mixture and then pour gently upon it a solution of Ferrous Sulphate ($FeSO_4$). If any Nitrates have been present in the liquids to be tested, a black ring will be formed at the junction of the two fluids. This black ring is a solution of NO in $FeSO_4$. The Nitric Acid has Oxidized the Ferrous Sulphate to Ferric Sulphate, and has itself been reduced to NO. For proof of this we have only to lead NO into $FeSO_4$, when, if carefully performed, the same black ring will be formed.

NITROUS OXIDE N_2O.

(1). By plunging a glowing splint of wood into a jar of this gas the splint will burst into flame.

(2). Phosphorous burns brightly in it.

Nitrous Oxide resembles Oxygen in many of its properties, so also does Nitric Oxide, but a glowing splint will not relight in the latter. Nitrous Oxide may be distinguished from Oxygen by the following tests:

(1). It has a sweet taste, Oxygen is tasteless.

(2.) It is more soluble in water than Oxygen.

(3). By the introduction of Pyrogallate of Potash into Oxygen, the latter is absorbed and a black solution left. There is no reaction when the compound is brought into Nitrous Oxide.

Nitrous Oxide may be distinguished from Nitric Oxide in the following way:—ruddy fumes are formed by the contact of Oxygen and Nitric Oxide. No fumes are formed when Nitrous Oxide is brought into contact with Oxygen.

NITRIC OXIDE N O.

(1) This gas is distinguished from all other gases by the formation of ruddy fumes in the presence of Oxygen, and it is distinguished from Oxygen by not being absorbed by the pyrogallate of potash.

NITROGEN TRIOXIDE N_2O_3

This compound can be condensed to a liquid at a temperature of—18°C. By the addition of water, Nitrous acid (HNO_2) is formed. The reaction is as follows:

$$N_2O_3 + H_2O = 2HNO_2$$

This acid is unstable and easily decomposes into Nitric acid, Water and Nitric Oxide.

$$3HNO_2 = HNO_3 + 2NO + H_2O.$$

NITROGEN TRETROXIDE NO_2

(1). This compound can be condensed to a yellow liquid at a temperature very slightly below the freezing point. If a mere trace of water is present it is green; and if a little water be added, drop by drop, it becomes deep blue and then colorless, giving off bubbles of gas, (Nitric Oxide), while Nitric Acid remains in the liquid.

(2). Nitrogen Tetroxide produces a red color in a neutral solution of Sulphocyanide of Potassium.

NITROGEN PENTOXIDE N_2O_5

This substance unites with water to form Nitric Acid, thus:

$$N_2O_5 + H_2O = 2HNO_3$$

This acid may be tested.

AMMONIA NH_3; mol. wt. 17; N = 14, H = 3, *i. e.*, 1 vol. N + 3 vols. H when united form 2 vols. of Ammonia, hence density = 8.5.

Physical Properties:

(*a*) Harsh alkaline taste, when diluted with water.

(*b*) Doe not support combustion, but has a tendency to burn. It will burn with a greenish flame if a stream of it, mixed with Oxygen, be passed into a jar of the latter.

(*c*) It is lighter than air.

(*d*) It is very soluble in water; cold water will dissolve about 1100 vols. of it.

(*e*) It has a very pungent odor.

(*f*) Condenses to a liquid at—40°C, or under a pressure of 6 to 7 atmospheres. At—75°C it becomes a transparent solid.

Chemical Properties:

(*a*) Turns red litmus, blue.

(*b*) Turns the purple solution of red cabbage, green.

(*c*) Turns solution of turmeric from yellow to brown.

(*d*) When a glass rod is dipped into any of the volatile acids, then exposed to the vapor of Ammonia, dense white fumes are formed.

(*e*) When Ammonia is passed into a solution of any salt of Copper, it will first produce a greenish-blue cloudy precipitate, but upon further addition this is dissolved and a splendid azure blue solution is left.

(*f*) NESSLER'S Test. If Mercuric Iodide ($Hg I_2$) be dissolved in Potassic Iodide (KI) a clear, colorless solution is formed; if, after the addition of an excess of sodic (NaOH) or Potassic (KOH) Hydrate, this be poured into a liquid containing ammonia (even the smallest trace—say $\frac{1}{100}$ of a grain to $\frac{1}{2}$ pint of water) a brown precipitate, or, if the quantity of Am. be small, a yellow color will be produced, thus:

$2\ HgI_2 + 3\ KOH + NH_3 = 3\ KI + 2\ H_2O + N\ Hg_2\ I, H_2O$, and it is to this latter product, Tetra Mercur-Ammonia Iodide, that the color of the precipitate is due.

(9). Ammonia Chloride, $NH_4\ Cl$, forms with Platinum Chloride, PtCl, a white crystaliine precipitate$=(NH_4\ Cl)_2\ Pt\ Cl_4$

LATENT HEAT.

PROFESSOR Maury has given the following explanation of Latent Heat.

If we take a cubic foot of ice and place it over a lamp capable of giving out just 1° of heat a minute, in a few minutes the ice begins to melt. The temperature of the ice is then 32° F. If we allow the lamp to burn under the ice for 143 minutes, at the end of that time all the ice will be melted, but the thermometer placed in the water immediately afterwards will show the temperature to be still 32°. What has become of the 143° of heat which the lamp must have given off? It has converted the ice into water and is *concealed* in the water. Heat in this form is therefore called *latent.* It is called sensible heat as it comes from the lamp. If we allow the lamp to burn under the water obtained from the melted ice for 967 minutes longer, the water will then have been converted into vapor and 967° more of sensible heat will have been changed to latent heat. In the whole operation of converting the ice to vapor, therefore, about 1100° of heat have become latent. If we were to reverse the process and convert the vapor so formed into ice again, about 1100° of latent heat would become sensible heat. This result takes place when a cubic foot of hail stones is formed.

The one operation is called evaporation the other precipitation.

It is very easy to understand what is meant by latent heat and since heat is the motive power of the world it is of the greatest importance that its nature and effects should be understood at the commencement of the study of Physical Geography.

One of the great questions in Physical Geography is the distribution of heat and moisture over the surface of the earth. We know that owing to unequal temperature there is a constant circulation of the atmosphere between the colder and warmer regions of the earth. The winds, evaporation, unequal temperature, the rotation of the earth and other causes produce the ocean currents which interchange the waters of the polar and equatorial regions. The currents in the ocean and in the atmosphere carry the superfluous heat and moisture from the Torrid Zone to the North and South and bring in return cold water and the cold dry atmosphere.

Professor Maury says that between the equator and the parallels of 25° North and South there are 112,000,000 sq. miles of water. In this region evaporation is largely in excess of precipitation. In fact the total quantity of water evaporated would be sufficient to cover the whole earth, land and sea to the depth of three feet. Now, we know that the sea receives from the sun as much heat as the land, but that a great deal of this heat becomes latent instead of being radiated. It becomes latent in the equatorial regions, is carried North and South by the currents of the ocean and of the atmosphere, and there becomes sensible heat. If one cubic foot of water contains stored up in it 967° of heat, what is the effect of the distribution of the latent heat, from the evaporation which takes place over 112,000,000 square miles of water?

By a knowledge of these facts and of the directions of the winds and currents in the ocean we can understand why the climate of one country differs from another. The winds from the South-west bring heat and moisture to the British Islands. The cold winds from the German Ocean condense the moisture and thus cause too much rain in England and Scotland. We can understand why Italy is the garden of Europe, why the Gulf of Mexico and the West Indies are not the hottest most pestilential regions in the world, why Boston has the same summer temperature as Quebec and Winnipeg, why the Sahara, Egypt, Persia and the Desert of Gobi make up the largest rainless district in the world, why the Amazon is the largest river in the world, why it has no delta, why the middle of Australia is a desert. We can explain why a cloudy day in winter is often warmer than a clear one and why we feel the atmosphere become so warm before a shower of hail.

ENGLISH LITERATURE.

QUESTIONS ON LADY OF THE LAKE.—CANTO I.

(Continued from the last Number.)

23. Describe the Spenserian stanza. State its effect. Give some account of its history and use by Scott and other contemporary writers.

24. Write a note on Invocations, giving the history and use, and explain what an Invocation should contain.

25. Criticise the manner in which the story opens, and refer to the art shown in introducing the chief characters.

26. Remark upon Scott's fondness for proper names, and their peculiar effect on his style.

27. Point out instances of imitative harmony in the description of the chase.

28. Enumerate and define with examples the rhetorical figures of repetition.

29. Define and give examples of the varieties of Metonymy.

30. Characterize Scott's descriptive powers, and point out the poetical peculiarities of his description of the Trosachs, as found in the eleventh stanza, noticing the plan of description, method of conveying form, color, &c.

31. "And ne'er did Grecian chisel trace
A Nymph, a Naiad, or a Grace."
Are references to Grecian Mythology in harmony with the general tenor of the poem?

32. Write a note on the delineation of character in fiction. What position does character occupy in the present poem? Characterize Scott's objective and creative power in this respect.

33. Write a note on the use of the supernatural in poetry in general, and in this poem in particular.

34. Point out the beauties and objects of the dream in this Canto.

35. Remark upon Scott's narrative powers, and state any circumstances or expedients employed to arouse and maintain the interest of the reader in this Canto.

36. Give your opinion of Scott's power in personal portraiture.

37. Describe, after Scott, the Trosachs

38. Give a synopsis of Canto I.

CANTO II.

39. Write a note on the subdivisions and headings of the poem.

40. What effect is gained by the introduction of such a personage as Allan Bane?

41. Criticise the love interest in the L. of L.

42. Explain the object, peculiarities and effect of the dialogue in the beginning of Canto II.

43. Give a note on the various instances of friendship in the poem.

44. Describe the approach of Roderich Dhu. What art is here shown by the poet?

45. Quote the opening picture and the passage describing the meeting of Ellen and Douglas.

46. Characterize the quarrel in Canto II.

47. Enumerate the chief events in Canto II.

CANTO III.

48. Point out the artistic beauties in the morning scene.

49. Write a note on the consecration of the fiery cross, and the nature and effect of the mysterious ceremonies attending it.

50. Show the various means of maintaining the interest in the description of the consecration of the cross.

51. What is poetic irony? Give an example of it.

52. Give your opinion of the third Canto as a whole, and in its connection with the other Cantos.

(*To be Continued.*)

DRAWING.

It is of the greatest importance that drawing should be taught to the rising generation as a branch of *general education*. The importance of this subject is so great that it is incumbent on those interested in the progress and well-being of the people to give this subject the consideration it deserves. That drawing should form a part of a *liberal* education must be admitted by all who fairly consider the question, it being an efficient and simple means of quickening the *perceptive faculties*, as well as being a practically *useful power* to most persons in all the walks of life. Those who can draw can *observe* and *express* more than would otherwise be possible to them, as no verbal or written statement can make evident the many peculiar shapes and appearances of things or places so readily as drawings can. The general appreciation of illustrated literature, and the multitude of maps, diagrams and pictures used for educational purposes prove this; indeed the fullest, simplest and best way to describe the form of anything is to draw it. Let the reader describe in writing the form of an article he wishes to have made, and contrast it with a drawing of the same thing, and the superiority of the latter will be demonstrated.

Drawing has likewise the advantage of being easily understood by all persons, and is a simple kind of *short-hand*, which requires no translation. Those who travel will not be able to make clear to others the important or interesting things they may see unless they possess this *art*, which is not only useful but delightful.

Drawing increases the *power of the eye* by systematically expressing it; while an uncritical habit of observation will permit the beauty and point of many things to escape notice. This is no unimportant matter, and no one who knows the power the eye gains by learning to draw would willingly dispense with it. It is also useful to copy wayside flowers and plants, that something of their beauty may be realized; since to the educated eye the richness and loveliness of the humblest drapery of the earth is very conspicuous and eminently impressive.

It is sometimes said that drawing can be successfully taught to those only who have a special *taste* or *genius* for it: but this is absolutely untrue, as experience proves that it can be acquired by all possessing *average* ability. Many, of course, learn readily and with pleasure, while others progress slowly and painfully; but as on the one hand the most gifted have to labor hard, still the patient are always successful in the end.

When parents decide what branches their children shall study, they never pause to consider whether they have a genius for reading or writing, or a taste for grammar or arithmetic; indeed, this stumbling-block only arises when drawing is in question; because parents and guardians too often know nothing about it, and strangely imagine that drawing means some *high art* for which rare genius is necessary.

Drawing, as a means of *educating* the hand and eye, is attainable by all; and those who feel a difficulty in mastering those first principles may console themselves by recollecting that many of our greatest scholars and literary men gave but small promise of success in their early days. Real artistic work requires an expenditure of time and energy; but when it is remembered what time is required to master the difficulties of penmanship, or the piano, it is only fair to consider drawing as a serious study, and allow a reasonable time for its acquisition. Drawing should be looked upon as a sort of descriptive writing, and we trust yet to see the time in this country when it will be as generally understood and practised as penmanship.—*The Notre Dame Scholastic.*

PRACTICAL WORK OF THE SCHOOL ROOM.

Should a pupil be told what he can find out for himself?

As a rule, a pupil should not be told what he can find out, *in reasonable time*, for himself. Pupils should be trained to rely upon themselves as much as possible, so that they acquire a habit of self-reliance—a very necessary qualification in the character of man or woman. But many incidental questions arise during recitation and at other times, which the pupil could answer, though the inconvenience of doing so, occasioned by not having at hand the proper sources of information, would be greater than the advantages to be derived from it. To illustrate—if while hearing a class in physics I should use the term meter, and should be asked the meaning of it, I would not say, "Go to the arithmetic and find out the meaning yourselves." I should tell them at once, and so make better use of the time. Still I am of the opinion that a prevailing prominent error in our system of instruction is giving too much assistance—telling too much. It is producing a crop of imitators. The pupil who is helped all along the way will be neither able nor willing to "paddle his own canoe," or if he attempts to do so will be ingloriously capsized.

How far should a pupil be assisted in the preparation of his lesson? Just so far that he may know how to go about the preparation of it in a proper way. If the lesson is unusually difficult, it is proper for the teacher to point out the difficulties and suggest their solution, but no more. Pupils should be taught that the lesson is a trial of their strength, and that to fail is to acknowledge defeat, but that to succeed is to score a victory. I think, too, that by helping pupils a good deal, they come to distrust their own ability, and this is, in many cases disheartening and enervating.

What is the difference between teaching and talking? Teaching is communicating to another the knowledge of that of which he was before ignorant. It is educating. Talking is familiar or unrestrained conversation. Now, to communicate knowledge or to educate, some conversation is necessary. (And I would say here, in passing, that the conversational plan of teaching is the proper one for quite young people.)

But teaching differs from talking in that the former is not unrestrained conversation. In teaching, conversation has a special aim, and that is to hold the minds of the pupils closely on the subject of the lesson, resolutely refusing to entertain irrelevant thoughts, or give expression to them. In talking restraint is kept at the minimum.

The design is to make all hands feel free and easy; and this is done by purposely avoiding all mental effort. In teaching, the minds of both teacher and taught are on the alert, ready and eager for *work*, and not play. The subject is developed and presented in a logical way, the end being kept in view from the beginning to the close of the lesson. In talking the mind throws off its guard, throws down its defence, and solicits and gives expression to ideas relevant and irrelevant, sensible and nonsensical. No attention is paid to the critical and logical elaboration of a subject, because that requires effort. Those who are in the habit of playing teacher in familiar intercourse instead of instructing or pleasing their audience usually bore them. The teacher who is in the habit of descending to familiar talk with the class on the lesson in hand, will be considered by the pupils a capital fellow, but no teacher.

In teaching the pupils do most of the speaking. In talking the teacher does the most of it. I have known teachers who, instead of having pupils recite to them, seemed anxious to recite the lesson to the pupils. When the teacher is well prepared, this will assume the form of a lecture, but when unprepared will become attenuated into the air, or degenerate into mere gabble. Sometimes a teacher should talk, once in a while should lecture, but his main business is to *teach*.

Should a teacher confine himself to the printed questions of the author? The principle referred to and the remarks made in reply to the question concerning the use of text-book by the teacher in recitation will apply here. Besides, a pupil may answer the printed question correctly, and yet not know the meaning of it. In short, it is better for the teacher to make his own question, even if they are not quite as good as those in the book; because if he depends constantly for his questions on the book, he will never acquire the art of questioning.

Why are the "leading questions," or questions that can be answered by Yes or No, objectionable? "Leading questions" are useful in recitation when it is desirable to have a pupil commit himself when he purposely or otherwise refuses to come to the point. But they are usually objectionable, 1. Because they provoke very little effort on the part of the pupil as to thought, and none at all in the expression of it. If there is no effort required in the recitation, no effort will be made for it. 2. Because the teacher has to do all the reciting, and it is not his business to recite.

Should the teacher reject partial answers and require every answer to be expressed in good language and in a complete sentence? Of course, every answer ought to be given in good language. I do not think, however, that *every* answer should be in a complete sentence. When a single pupil is asked a question I think the answer should be in a complete sentence, when that sentence is not necessarily stereotyped. For example, take the following questions: What is the capital of Ohio? Ans. Columbus is the capital of Ohio. What is the capital of Pennsylvania? Ans. Harrisburg is the capital of Pennsylvania. What advantage have these complete sentences over the mere words Columbus and Harrisburg? Those who say every answer ought to be a complete sentence should require their pupils to say, "There are 16 drams in one ounce; there are 16 ounces in one pound," etc. But when the sentence admits of a variety of construction, and hence some ingenuity and effort on the part of the pupil, then they should be required; for one purpose of the recitation is to train pupils in correct expression.

In questioning a class as a whole, either the answer in a single word, or the stereotyped sentence is to be preferred to the other, because if each one of a dozen had a different sentence, there would be a Babel of confusion, and no answer understood.

Penn. School Journal.

EDITORIAL NOTES.

We have received a communication in reply to the attack made on the management of the Hamilton Schools in the last issue of a contemporary educational journal. As the reply is written in the same style of personal detraction as the editorial in question, we must decline to give it publicity through the medium of our columns. We cannot consent to prostitute THE SCHOOL MAGAZINE to satisfy the personal animus of anyone, or to lend its pages to the furtherance of private, at the expense of public interests.

Industrial Education, we are told by the editor of an educational journal, is just the thing now for Canadian Schools. To amplify the public school course of study seems to be the aim of a few educational quacks; "rudimentary work-shops" are to be started in connection with the public schools for the boys, and the girls are to be taught domestic work. "If gown making, pie baking and carpet shaking are to be bundled into the curriculum of the female department of the public schools, why not teach the boys to make their own boots and paper collars?" If girls are to be instructed how to chop and season and fry sausages, why not train the boys to stick pigs, and give them practical lessons in the general science of butchery? In short, why not put every pupil, male and female, through a special scientific or industrial course, and turn out specialists in white-washing, laundry work, bar-tending, undertaking, hair-dyeing and all the other useful and decorative arts which highly civilized mankind finds essential to his comfortable existence?

It is not within the province of the public school to furnish boys and girls at public expense with hammers and turning lathes, and "rudimentary" wash-tubs, but to give them the most thorough discipline and training in those fundamental studies which are the keys to all treasures of knowledge. It is best not to overload our public school curriculum with more subjects, but to give better instruction in fewer branches. Drawing, the foundation of industrial training, should be more extensively taught than it is, and, when we can afford it, by all means let us have special training schools, where industrial arts can be taught, but beyond this it is not the duty of the Province to go.

THE 'VARSITY.—Under this name appears a paper conducted by the students of University College, Toronto. We think a more suitable name might have been selected, but what's in a name? Such periodicals are often of great service to students and graduates of the college, if efficiently and independently conducted. The 'VARSITY, professing modestly to be a mere register of current student life will, as such, be welcome to many who have long since left the halls of their *alma mater*. We wish the 'VARSITY every success and hope to see it run a long and useful career. The current number lifts us somewhat out of student life. Some of the articles are by mature minds and suggest thoughts that are of importance to more than students. A biographical sketch of Dr. McCaul is completed in the present number. It is well written and interesting but perhaps the writer indulges slightly in the idealizing effect of poetic exaggeration so common with biographers. An article by Mr. J. Hodgins gives useful legal information on the subject of university representation in the parliament of Canada, but we suppose Ontario is meant; as educational affairs are legislated only in the Ontario Assembly, a representation in Ottawa would be useless and absurd. We extend a friendly greeting and welcome to the 'VARSITY and wish it a long and prosperous life.

A correspondent writes to us, recommending the following changes in the manner of conducting the 1st and 2nd class examinations:—

(1) That the examination papers for 1st class be printed (by a lithogram or papyograph press) on the day of examination, and in the Examination Hall, under the direction of the examiners.

(2) The distinguishing numbers of candidates, at both 2nd and 1st class examinations, should be kept a secret from pupils and examiners. This, he points out, can be done by providing each candidate with a blank book in which to write his answers, and instead of the envelope now in use, let there be a cover for the blank book with a fly leaf for candidates name, school and post office address: this fly leaf could be removed by a clerk in the department, entrusted with the registering of candidates, and the number assigned to the candidate in the register could be written legibly on the outside of the cover under the name of the subject of examination. The blank book, he further says, could be made at little expense, and should consist of either one

or two sheets of foolscap paper enclosed in the self-sealing covers. It would require for Algebra, Arithmetic, Literature, Composition, and Dictation, Geography, History, Natural Philosophy, Book-keeping, Chemistry, Latin, French and German, 4 pages each; and for Euclid and English Grammar 8 pages or 2 sheets of foolscap paper.

Those who select Latin, French, or German would require nine blanks, or eleven sheets of foolscap. Those who select Natural Philosophy, Chemistry and Book-keeping would require eleven blanks or thirteen sheets of foolscap paper. On an average each candidate would require half a quire of paper—a great saving to the Province in the matter of paper alone. The advantages claimed for this scheme are as follows:—

(*a*) It would be less expensive than the present plan of conducting examination.

(*b*) None of the answers given by pupils could be lost, as the sheets would be fastened together in the form of a book.

(*c*) There would be less clerical labour; only one list of pupils from a school need be made out.

(*d*) No candidate would be "*ruled out*," and lose a year by not applying—a month before the time of examination.

3. The examination papers and blank books could be charged to the schools to which they are sent and the amount deducted from the government grant; the *probable number* of candidates at each school could be sent to the department in time to have the papers printed and sent off.

4. On no account should candidates from the same school receive consecutive numbers.

5. The answers of candidates should be sent to the department on the evening of each day of examination. This would provide against the possibility of tampering with the papers while in the custody of the presiding examiner.

6. Teachers and Candidates should be put in possession of all regulations affecting these examinations before the time of examination.

The changes recommended by our correspondent are not new; the examination papers at the examinations of University College, at the matriculation examinations of London University, and at the examinations of the Medical Council, are either lithographed or printed in the way he recommends. Blank books are used at the matriculation examinations of London University, and at the local examinations of McGill University the answers of candidates are sent to the University authorities at the close of each examination, and the examination papers are sent off by the registrar so as to reach the school on the day of examination.

PERSONALIA.

The winner of the Dominion Gilchrist Scholarship, Mr. Pickard, B. A., of New Brunswick, was disabled in his right arm a few days before the examinations were held, and he employed the services of an amanuensis in answering the questions set.

The next examination for the admission of pupils to High Schools and Collegiate Institutes will be held on Tuesday and Wednesday the 21st and 22nd of December.

The Owen Sound Board of Education have just completed their new High School building; it is said to be one of the best arranged school buildings in the Province.

The Chatham High School is in a very flourishing condition, and is well prepared to do Intermediate and University work.

F. Michell, B. A., has resigned the principalship of the Perth Collegiate Institute to take the inspectorship of the County Schools.

An unsuccessful at[illegible]mpt was made to unite the countie[illegible] of Russell and Prescott for the purposes of Public School inspection. Mr. Sumerby, head master of the Model School at Kingston, was appointed inspector, and he is to be assisted in his work by Mr. O. Duford, a French Canadian Teacher, who will look after the French schools in these counties.

The Perth promotion examination papers will appear in the next issue.

NORTHERN FAIR, COUNTY OF MIDDLESEX, COMPETITIVE EXAMINATION.

ARITHMETIC.

Class—13 to 15 years.

1. A man bought a quantity at $15 for 20 cwt. He sold it at 85 cents per cwt, gaining $22.25. How many cwt. did he buy?

2. Find the smallest number that can be taken from $151\frac{1}{2}$, so that the remainder may exactly contain $19\frac{1}{11}$

3. A man's annual income is $2,400; find how much he may spend per day so that, after paying a tax of 2 cents $7\frac{1}{2}$ mills on every dollar of income, he may save $582 a year (365 days.)

4. Reduce $\frac{5}{17}$ to an equal fraction whose numerator is $13\frac{1}{3}$ more than its denominator.

5. A and B have together 210 acres of land, and $\frac{3}{4}$ of A's share is equal to $\frac{6}{7}$ of B's share. B paid $1,470 for his land; for how much must he sell it to gain $20 per acre?

Class—11 to 13 years.

1. How many minutes from half-past ten in the forenoon of January 5th, 1880, to a quarter past three on March 3rd of the same year?

2. Bought 40 gallons wine at $2 per gallon. How much water must be added so that $30 may be gained by retailing it at $1.30 per gallon?

3. Find the difference in grains between 6 ounces Avoirdupois and 6 ounces Troy.

4. How far from the end must a stick of timber, 14 inches wide and 17 inches deep, be cut to have one cubic yard?

5. When is a fraction said to be reduced to its lowest terms?

Class—9 to 11 Years.

1. Find the difference between 8090 times 6070 and a number 8016 less than a million and ten.

2. What is the smallest number that can be taken from 4963810731 so that the remainder may exactly contain 2987?

3. Twice the remainder is 78336, the subtrahand is 10695; find the minuend.

4. The divisor and quotient are each 9040, find the dividend, supposing the remainder one-fourth of the quotient.

5. Fifty-nine bags of oats, each containing two bushels, cost 8024 cents; find the price per bushel of 34 pounds.

GRAMMAR.

Class—13 to 15 Years.

1. Parse italicized words:

Which do you advise *to take.*
He went *home alone.*
He *alone* went home.
It is *easy to say that.*
John, get your lesson.

2. Correct, if necessary. Give reasons:

He who was walking began to run.
I do not want no more of them apples.
Every boy and girl were there.
I kind of thought you was alone.

3. Punctuate:

He however did not do it
Sir did you say so
Alas how he has suffered
I will do it if he asks me

4. Write neatly six rules of Syntax. Compose a sentence to illustrate each. Explain how the rule is applied.

Class—11 to 13 years.

1. Punctuate the following sentences:

How sad how dreary how desolate is this scene
John shall I never be able to trust you
No man indeed is always happy
The signal being given we sailed away
Ella Waters Mr. Cuddy's pupil won a prize

2. Correct these sentences. Give reasons for changes.

Him and me didn't have to do it.
Strathroy is larger than any town in Middlesex.
These kind of people are mean.

Jennie is the smartest of my two daughters.
My cold is perfectly awful.

3. Parse, John and Henry, you may go home.

4. Combine the following into a simple narrative:

A man came to town.
He wore a valuable coat.
The buttons were made of ivory.
The man stopped at a hotel.
During the night the buttons were stolen.
Six pounds £s were offered for their recovery.
The man never got the buttons.

GEOGRAPHY.

Class—13 to 15 years.

1, Name the provinces of Canada in order from the west. Give two rivers in each. State accurately the size of each.

2. Through what waters would a vessel pass in going from Chicago to Odessa?

3. Explain why the days are sometimes longer than the nights.

4. Give in order any ten Canadian ports and tell their situations.

5. Outline a map of Ontario. Mark the cities. Draw the railroads connecting them and write their names on the lines.

Class—11 to 13 years.

1. Name the Provinces of the Dominion of Canada and state the No, of sq. miles in each.

2. Through what counties would you pass in going from Hamilton to Chatham by the G. W. R. R?

3. On what railroads are the following: Orangeville, Owen Sound, Collingwood, Oakville, Coboconk?

4. Six counties border on Middlesex, name them in order.

5. Draw an outline map of Middlesex.
   (*a*) Mark the townships.
   (*b*) Cities, towns and villages.
   (*c*) Show the routes of the two principal railroads.

Class—9 to 11 years.

1. How does an island differ from a peninsula; a pond from a lake; a river from a creek; a mountain from a hill; an ocean from a sea?

2. Define cape, bay, prairie, valley, desert.

3. Mention two or more reasons for believing there is water under surface of the ground.

4. Name five animals we use for food.

5. How do you know north, south, east, west? Draw a diagram to illustrate your ans.

READING.

Class—13 to 15 years.

The *inhabitants* of *terra firma* were *ignorant* of the *agitation*, which, on the one hand, the *volcano* of the island of St. Vincent had *experienced*, and on the other, the *basin* of the Mississippi, where, on the 7th and 8th February, 1812, the ground was, day and night in a state of *continual oscillation*.—(iv. book, 151.)

1. Define the italicized words.

2. What word or words understood after 8th.

3. Give the substance of the extract in your own language.

4. Locate the island of St. Vincent.

5. Write 2 verses from Bernardo del Carpio.

Class—11 to 13 years.

Tell the meanings of the italicized words.

1. The cook *withdrew*, *assuring* his master that his wish would be *gratified*.

2. With *mast*, and *helm*, and *pennon* fair,
   That well had borne their part.

3. A *ground-squirrel retires* to a *burrow* during the winter and *hybernates*.

4. *Puppy!* that cursed *vociferation*
   Betrays thy *life* and *conversation*.

5. The *supply* of food in the *vicinity* of the *dam* becomes *diminished*.

6. Humming-birds are *natives* of America.

7. Write four words requiring a hyphen.

8. Carefully write 3 verses of Casabianca.

Class—9 to 11 years.

Re-write the following, and for italicized words use their meaning.

1. His lands became *barren*.
2. Only *drones* need hunger still.
3. *Courage* and *presence of mind* are qualities every one ought to try and *possess*.
4. In *token* of their *duty* and *subjection* to him.
5. The *poultry* were free from *mishaps*.
6. Not liking the too great *complaisance* of his master.
7. Open your *hospitable* door.
8. *Cowards determine* to tell lies.
9. In lark and nightingale we see
   What *honor* hath *humility*.
10. It was *endured* with *patience*.
11. Write two verses from the story of the beggarman.
12. Give the names of six birds mentioned in the second book.

HISTORY.

Class—13 to 15 years.

1. Name the Tudor Sovereigns, give dates of accession; date a leading event in each reign.

2. Mention any English kings that met a violent death.

3. Tell what you know about Wellington, Walter Raleigh and John Bunyan.

4. Sketch Henry VII.'s reign.

5. Describe as fully as you can the corporation of our Canadian Parliament.

Class—11 to 13 years.

1. Give the agreement made by Cardinal Richelieu with the company of One Hundred Associates.

2. State accurately the methods adopted by the British Government to reward the United Empire Loyalists.

3. Mention the provisions of any treaty affecting Canada

4. Write any six dates between 1492 and 1880, and attach a historical event to each.

5. Why is the study of history important?