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TECHNIQUE

REVUE INDUSTRIELLE
INDUSTRIAL REVIEW

DECEMBRE · DECEMBER

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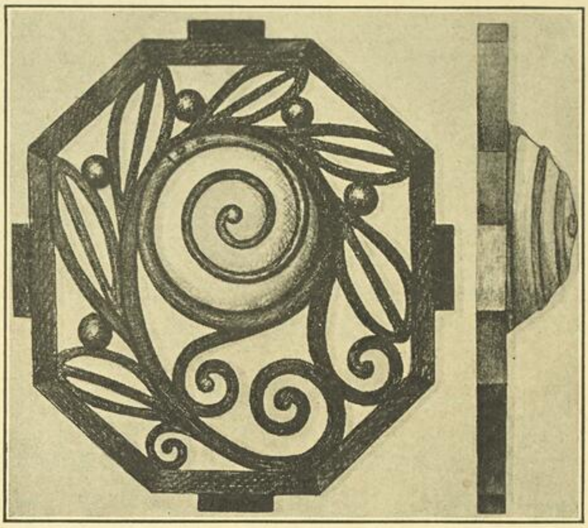

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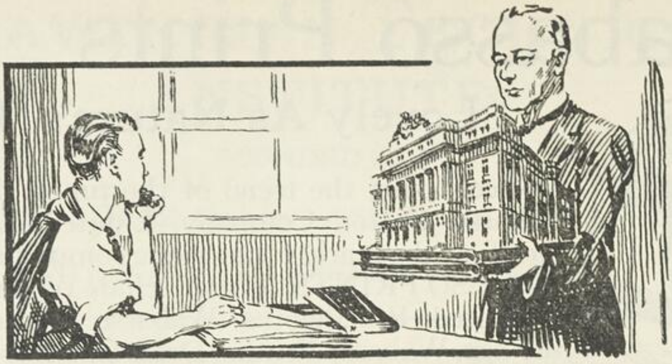
Tourist: "Is the water at this hotel pure?"

Guest: "Not very. We frequently find traces of coffee and other substances in it."



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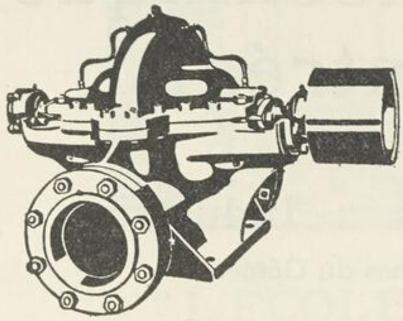

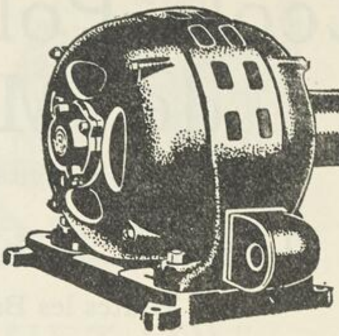

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TECHNIQUE

REVUE INDUSTRIELLE — INDUSTRIAL REVIEW

VOL. III DECEMBRE — DECEMBER N° 10

EDITORIAL

WITHIN comparatively recent years, there has come into vogue in the educational field, a new system of teaching, which for want of a better term we will refer to as "Book Training" as distinguished from the old style or "Demonstration by the Teacher". The former style of training, we believe, originated in the United States, where the book publishers, true to their commercial instincts, are seeking by all means to push the sale of text books of various kinds.

In a discussion of the merits of the two different forms of training, naturally each side can bring arguments to bear in favour of his own side of the question, and there is no doubt but that both forms have their advantages and disadvantages, a conclusion quite general in all matters of discussion. The proponents of the "Book Training" system claim that with the old system there is a danger of "Spoon-feeding" the student; in other words, there is a great tendency for the teacher to do all the thinking, while all the student has to do is to sit tight and take it in. We admit this possibility. We will not admit, however, that a slavish adherence to the other form of training will be productive of much better results, because in this instance it is the teacher who sits tight and simply watches the student as he sucks in his own knowledge, *if he can*.

We will admit that the "book" method training is far easier for the teacher, but carried to its ultimate conclusion, why go to school at all? Why not correspondence schools for everyone? It would save tremendous expense in teaching staffs, school buildings and equipment.

Like most other propositions of its kind, experience proves that while very beautiful in theory, it falls down in practice, if carried to extremes. The writer can remember in his own student days, being given a certain model to sketch, with the object of making a workshop drawing therefrom. He never really did know what was expected of him for the instructor seemed to think that all he was there for was to sit at his desk and watch the students work.

A little hint here and there on the part of the teacher may open up vistas to the pupil which he might otherwise never realize it left to his own devices, and before a boy can be left to himself to worry out his own problems, he must first of all be trained to think and this is where the teacher comes in. No book can adequately teach a student how to think, except in perhaps exceptional cases.

At the Montreal Technical School neither of these methods is used exclusively, but rather a combination of both. That is, a student is first shown how to reason things out for himself and then is given a chance by the "book" method to see if he is capable of working alone. But to assume that the average student can work all alone without any help on the part of his instructor is contrary to all experience and absolutely erroneous. The teacher should be available at all times to help the student over difficult passages.

A NOS LECTEURS

VOICI l'approche des fêtes et nous en profitons pour offrir à nos lecteurs, nos souhaits de paix, de santé, et de prospérité pour l'année qui va bientôt commencer.

TECHNIQUE entre déjà dans sa quatrième année. Quatre ans, c'est l'âge encore tendre où l'enfant commence à extérioriser les connaissances qu'il a acquises depuis son apparition en ce monde; déjà il rend des services, il fait de petites commissions, et pour cela il s'expose à des dangers, des chutes, des maladies. S'il est bien constitué, s'il a de bons parents qui en prennent bien soin, il traversera tout cela triomphalement. En sera-t-il ainsi de TECHNIQUE, passera-t-elle à travers les différentes épreuves qui l'assaillent. La réponse dépend de nos lecteurs, de l'attachement qu'ils ont pour *leur revue*, du zèle qu'ils déploient à accroître son champ d'action en la faisant connaître à leur entourage, en engageant leurs amis ou compagnons de travail à s'y abonner.

S'abonner et faire abonner les autres, voilà le mot d'ordre de cette année pour nos lecteurs. TECHNIQUE est composée et imprimée pour eux, pour leur seul bénéfice, qui est l'instruction, et non pas pour le profit des collaborateurs de la revue, car tout cela est fait gratuitement. Les techniciens se doivent donc de soutenir par tous les moyens cette œuvre importante Pour nous, nous offrons notre dévouement dans la mesure de nos forces et du temps dont nous disposons, et nos lecteurs peuvent être assurés que nous aussi avons un mot d'ordre qui est: *progrès*.

To our Readers

On the approach of the festive season, we desire to express our appreciation of the kind cooperation we have received from all sides towards the making of TECHNIQUE a success.

We wish to thank our advertisers and our readers, as well as those who, by contributing articles, have enabled us to produce a review which seems to fill a long-felt need in this Province.

To each and every one then, without exception, who have taken the least interest in our magazine, we wish a Merry Christmas and we trust that for them the coming year will be a very happy one indeed.

Five Kinds of "Sand"

There are five different materials used as abrasives in the manufacture of abrasive papers and cloths. First of all comes flint, the crushed quartz or "sand" with which most individuals are acquainted, and from which the common term "sandpaper" is derived.

Then there is garnet, the precious gem of the jeweler, which is used in this business in its impure, mined state. The upper reaches of the Hudson River Valley in the Adirondacks produce the best American grades; another variety is imported from Spain. It is much in demand as an industrial abrasive in woodworking and furniture factories.

Emery is a third material, used principally in the metal trades. Turkey supplies the best grades, with Greece and America supplementing the supply.

Emery is being rapidly supplanted by an artificial abrasive, aluminum oxide, which is sold under the names of "garalun" and "alundum." It is obtained by fusing bauxite clay, the ore of aluminum, in an electric furnace, then crushing and grading the resulting crystals. This abrasive is employed in working on metals of high tensile strength.

The fifth abrasive is silicon carbide, another artificial abrasive obtained by high-temperature fusing of sand (silicon) and charcoal (carbon) in an electric furnace. It is used principally on leather, and on metals of low tensile strength.

Don't Stay in a Rut

Two business women were talking, and when I say that they were employed in offices on an important railway I give away no secret. They were both ambitious, I should judge, and yet, there they stood, yawning.

"I'm tired to death," one said, of everything.

"So am I," the other added, "but I'm just lazy, I think. Stay that way all the time. Never feel like reading, or studying, or working. I hate everybody. Don't know what is the matter."

They are in a rut, that is the answer to their problem. And if they are not careful the rut will grow deeper and it will become more difficult for them to escape. Inertia has dragged them there, and nobody in its relentless grip amounts to much no matter what their natural abilities may be.

I should advise that they turn sharply and get some decided interest in life, especially in their work, or they will end in overwhelming failure.

It is easy to tell when the rut is engulfing us, and it isn't a matter of years, either. It is a matter of inner awareness, so L. D. Stearns says.

It is not necessary for us to leave our home, our work, our office, or wherever we happen to be, and roam to far distant places, in order to get out of our rut. We must just swing to higher ground. We can learn how.

Let us do something occasionally that takes downright grit and moral will-force to achieve, something that makes us shut our teeth hard and say, "I will." We shall feel a new, vibrant force sweeping into our veins when this is accomplished. Let us learn every day something new, something outside of our own particular line, as well as something especially to do with our job, no matter how well informed we are. A book that will teach us rather than amuse us, let us read. Let us do something kind, a lift of some sort given to some one where we know it is needed, but that we do not have to give. There are so many ways in which we can grow. There are unknown, mighty powers of growth waiting to be unlocked in every life, if we but find the key. And let us remember always, that "Out of the heart are the issues of life."

Let us look outward, over our own individual problems for a few moments each day. Let us note the beauties of other lives and of other places, and if restless we come to our jobs, let us consider the opportunities for growth and still more growth surely there for us, if we have the grit to avail ourselves of them. If we do this, we will mount, before we know it, toward the skies, and our jobs will give us outlet for our ambitions.

THE FACE THAT MEN FORGET

Two faces were close together, the hardware salesman's, grim and tense; the other face was small and white, with two slender hands pressed tightly against it. It was those frail hands that riveted the man's horrified gaze.

"Heavens!" he said, still staring; and his voice was tragic, for that other face was the face of his watch, and those little hands told him that he had missed the last train home.

IN YE OLDEN TIMES

It was back in medieval times.

"It's no fun trying to live in this coat of mail," complained a cootie.

"No," agreed the second parasite. "Heaven help a fellow on a knight like this."

Stair Building

By E. Morgentaler

Instructor in Building Construction, Montreal Technical School.

Part II

In the September, 1927, issue of Technique, a study of the planning and balancing of circular stairs was presented to the reader. We are reproducing here in Fig. 1, the plan of the stairs shown as Fig. 5 in that number, and will explain how to lay out the stringers.

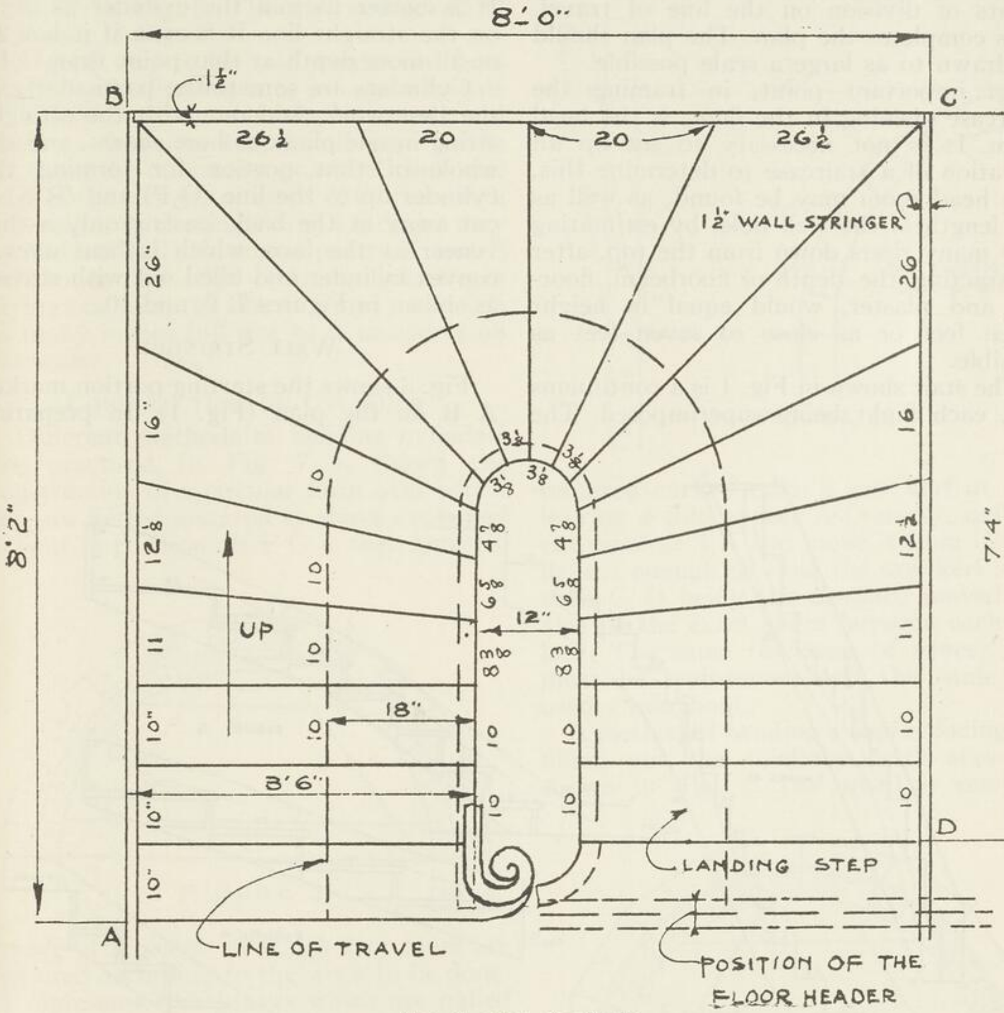


Fig. 1—Plan of a Stair

It is important in planning winding stairs of various forms, and this example will serve for all, to make the treads as nearly as possible of a uniform width on an established "line of travel" which is approximatly 14″ to 18″ from the front stringer as shown in Fig. 1.

In making a plan of the stairs, the first thing to be determined is the wall lines A B C D. Next, the width of the body of the stairs from the wall to the front stringer.

The width of the hall in this staircase

is 8′–0″ between rough walls and 3′–6″ the width of the stairs with 12″ diameter of cylinder.

The line of travel is drawn in position as before mentioned; the starting or first, and top of landing riser lines are now drawn as required. Between the starting and landing risers, on the line of travel, equal spaces are marked for the width and number of treads required. Next the treads in the cylinder and along the line of the front string are marked as shown and explained in the September issue of TECHNIQUE. The lines for the risers are now drawn from the points of division on the cylinder and front string through the points of division on the line of travel. This completes the plan. The plan should be drawn to as large a scale possible.

An important point, in framing the staircase opening in the floor, is the head room. It is not necessary to set up an elevation of a staircase to determine this. The head room may be found, as well as the length of the well hole, by estimating how many risers down from the top, after subtracting the depth of floorbeam, flooring and plaster, would equal in height seven feet or as close to seven feet as possible.

The stair shown in Fig. 1 is a continuous one, each flight being superimposed. The floor header should be placed as shown in dotted lines.

Laying out the Front Stringer and Cylinder

The distance G H on the front stringer (Fig. 2) must equal altogether the depth of timber, thickness of plaster and thickness of riser.

The cylinder is spliced to the stringers on the lines O P and (R S). The treads as given in the cylinder and stringers agree with the plan Fig. 1. The depth of the cylinder is found as shown by describing arcs of a radius equal to G H from the angles of tread and rise as shown at (U V). It is better to join the cylinder as at R on the straight line R S even if it has 2″ or 3″ more depth at that point than G H.

Cylinders are sometimes, particularly in the best work, laid out with the straight string in one plank as here shown, and the whole of that portion for forming the cylinder up to the line (O P) and (R S) is cut away at the back leaving only a thin veneer at the face, which is bent over a convex cylinder and filled out with staves, as shown in Figures 7, 9, and 10.

Wall Stringer

Fig. 3 shows the starting portion marked A B on the plan (Fig. 1). In preparing

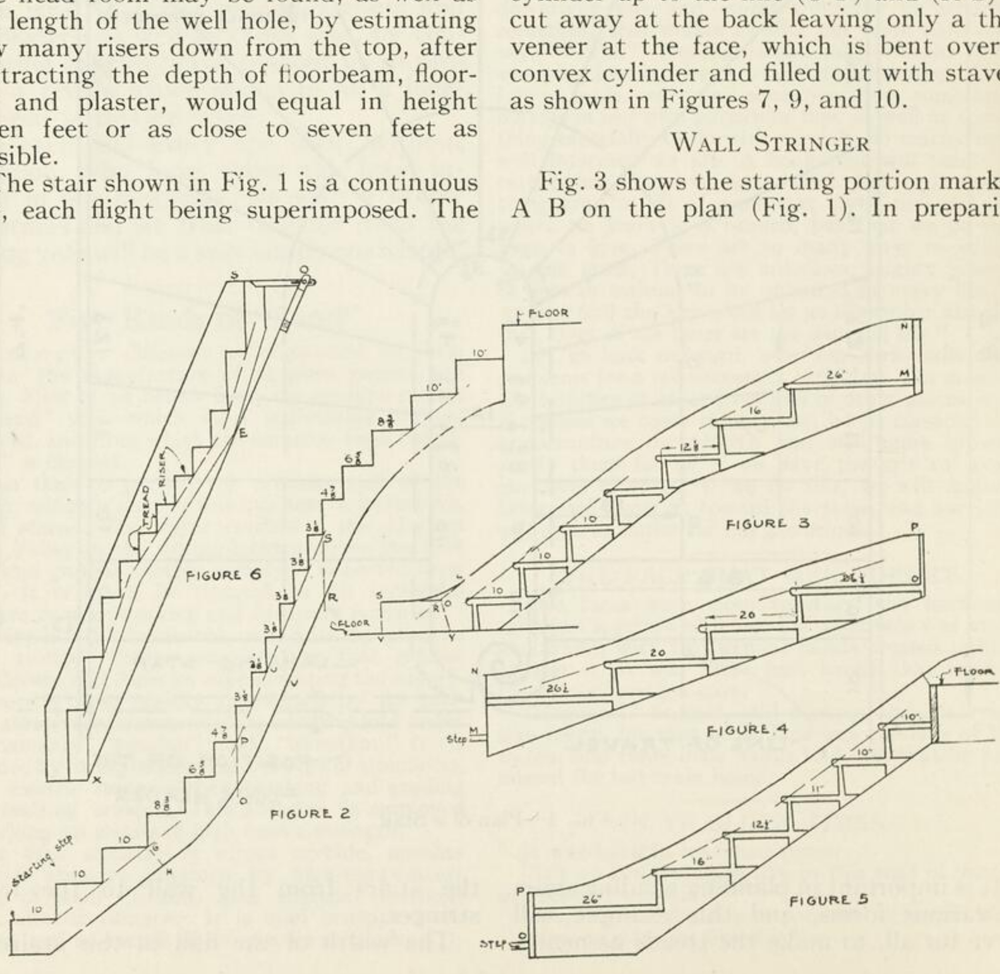


FIGURE 6

FIGURE 2

FIGURE 3

FIGURE 4

FIGURE 5

this stringer to join the floor base, the curve (S L) eases off the angle of stringer to the level of the base.

The stringer may be mitred to the base as at Y O, R Y being equal to V S. The height of stringer M N above the angle step must be the same as the step M N on the next stringer (Fig. 4) also the stringer connecting these angles may be brought to a level by curving as shown or it may be left angular. They must in all cases be brought to a level, so that the base mouldings will connect properly.

The wall stringer B C Fig 1 is shown in detail in Fig. 4. The height of the stringer at O P must be the same as the angle step at O. P. in Fig. 5. The wall stringer C D is shown in Fig. 5.

A good way to lay out winder stringers from a scale drawing is to set up to a scale of 1½″ = 1′-0″ an elevation of treads and risers as shown in Fig. 6 and draw a line touching the outermost points of the lower edge of the stringer as at (X E O) then with a bevel set to the angle O S, a stringer may be laid out full size whose points X and E will touch the edge of the plank. Begin laying out with the line O S and make O S as many inches full size as it measures on the scale.

Construction of Cylinder

Different methods of bending cylinders are practised. In Fig. 7 is shown the construction of a circular form over which the saw kerfed material as above explained is bent in position. E F G is the plank rib

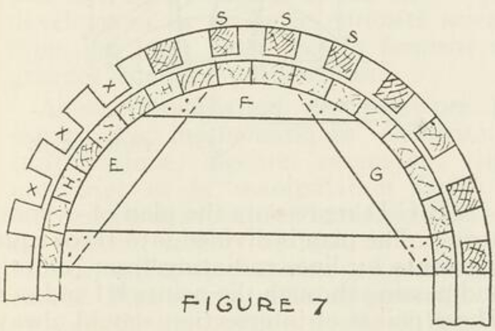


FIGURE 7

(made of 3 pieces) of which 2 or more are required according to the work to be done. H represents the staves which are nailed to the ribs and so complete the circular form. The wood is removed from the back of the stuff as at XXX etc., leaving the thickness of a veneer at the face after bending. The grooves XXX are filled with tightly fitted strips of wood (glued in) called keys as at S S S.

It greatly adds to the strength of this bent keyed work to glue on three strips of veneer, one at each edge of the keyed stuff and one in the middle. The glue should be perfectly dry before the work is removed from the form. The spaces between the keys may be determined by the following method:

To find the correct distance between saw kerfs for any required radius of curvature, select a piece of stuff of suitable length and equal to the thickness of the material to be bent (see Fig. 8) let A B equal the thickness of stuff and A C the radius of the

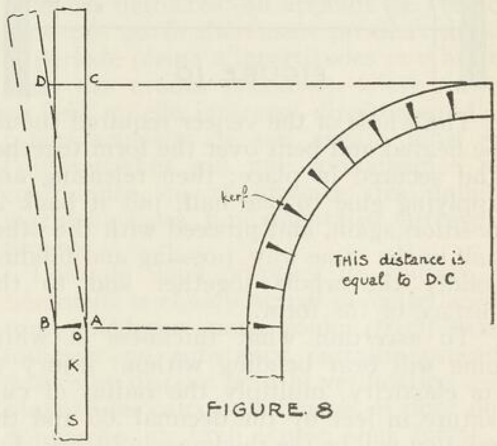


FIGURE 8

required curve; make a saw kerf at B O leaving a thin veneer A O uncut, nail the cut piece at S K and move it from C to D or just enough to close the saw kerf at B; then C D being the distance moved will also be the exact space between each saw kerf. The same thickness of veneer A O must be maintained and the same saw used throughout.

A method of bending a veneer facing and filling out the thickness with staves is shown in Fig. 9. The wood is removed

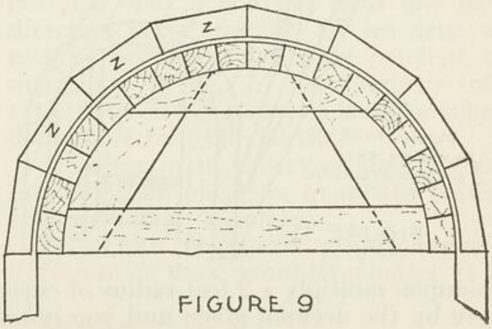


FIGURE 9

wholly from the back of the stuff between the points required, leaving a veneer facing which is bent over the form and then staves Z Z Z are fitted and glued on, as shown in drawing.

The laminated work method is shown in Fig. 10. Bending several thicknesses of veneer together is defined as laminated work.

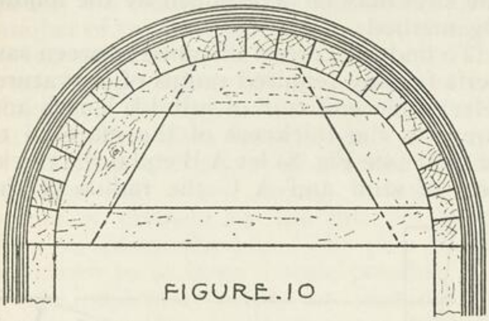


FIGURE.10

The whole of the veneer required should be heated and bent over the form together and secured in place; then releasing and applying glue to one half, put it back in position again, and proceed with the other half in the same way, pressing and binding solidly the whole together and to the surface of the form.

To ascertain what thickness of white pine will bear bending without injury to its elasticity, multiply the radius of curvature in feet by the decimal .05 and the product will be the thickness in inches. For

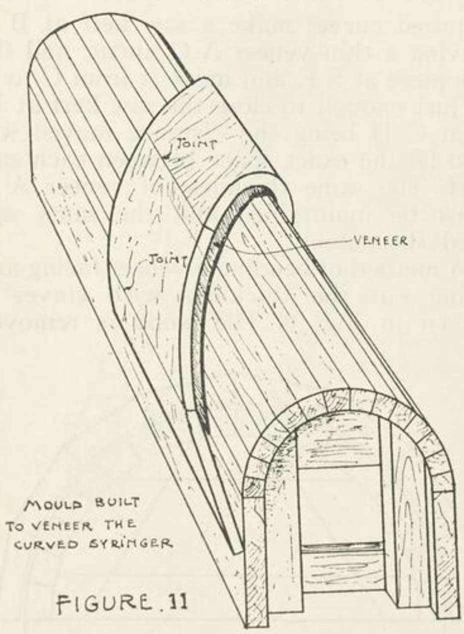


FIGURE.11

example, multiply a 2 feet radius of curvature by the decimal given and you obtain $2'0'' \times .05 = .10$ equals one tenth of an in. thickness. This would bend without fracture.

The construction of an ordinary form for bending stair stringer is shown in Fig. 11 where the correct position of a stair stringer bent in position is indicated. The ribs of this form are quarter circle and are set parallel to each other.

A method used where a strong stringer is required, is shown in Fig. 12. This drawing shows the plan, elevation and rabattement of a stringer on a quarter turn. The construction is as follows:

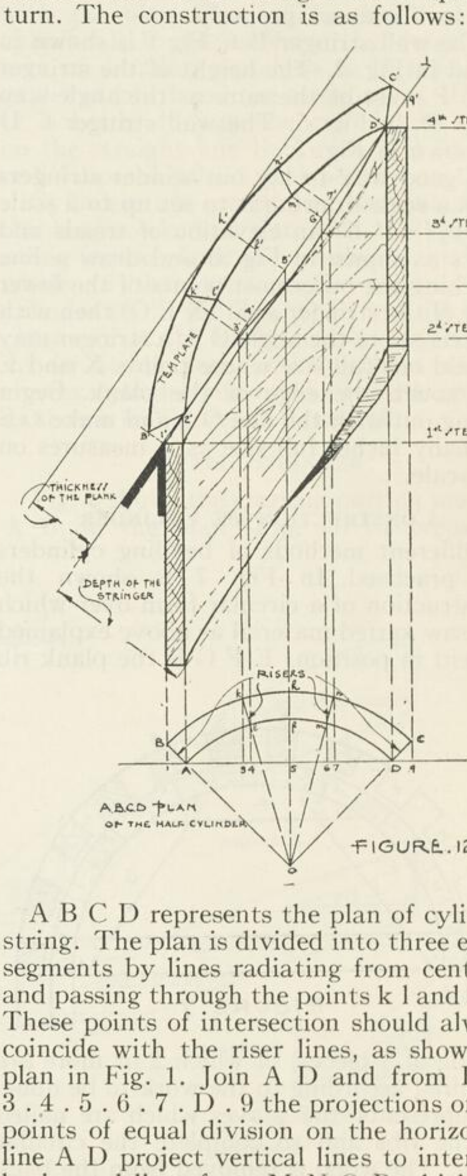


FIGURE.12

A B C D represents the plan of cylinder string. The plan is divided into three equal segments by lines radiating from center 0 and passing through the points k l and m n. These points of intersection should always coincide with the riser lines, as shown in plan in Fig. 1. Join A D and from B A, 3 . 4 . 5 . 6 . 7 . D . 9 the projections of the points of equal division on the horizontal line A D project vertical lines to intersect horizontal lines from M N O P which are separated by a distance equal to the height of a riser in each case.

(*Continued on page 20*)

Le Calcul Graphique à l'Usine

Par Alex. Bailey
Professeur à l'Ecole Technique de Montréal

"La vraie règle de bien juger est de ne juger que lorsqu'on voit clair".—*Bossuet.*

"*Savoir c'est pouvoir*" est un vieil adage qui ne cesse d'être vrai. Mais sa justification exige plus que la connaissance superficielle d'un fait, l'observation des circonstances qui l'entourent, voire même la déduction des causes immédiates, médiates ou premières qui peuvent l'engendrer. Il faut encore, et surtout, le moyen d'apprécier la justesse des observations et analyses que comporte l'étude détaillée de ce fait: à cette seule condition, le savoir devient une réelle philosophie des choses, une source vraiment féconde de réalisation même matérielle.

L'ouvrier est-il toujours entrainé à la solution de ce problème?

A cette question nous répondrons que l'écueil qui se dresse presque constamment sur sa route est son inaptitude à saisir cette philosophie des choses, conséquence du défaut de concentration, et de sa répugnance plutôt proverbiale pour l'étude des sciences exactes qui lui semblent quelque peu austères et stériles.

Cependant il lui est impérieux de faire large la part de la méditation, celle de la lecture appropriée et d'une étude parfois théorique, abstraite... Car, ne l'oublions pas, ce n'est qu'au prix de tels efforts qu'il développera en lui cette curiosité scientifique qui n'est autre que le ferment des grandes énergies industrielles.

Ainsi, l'assimilation des principes basiques des mathématiques élémentaires (arithmétique, algèbre, géométrie, trigonométrie) et la manipulation facile du mécanisme des formules fondamentales qui en dérivent seront, de tout temps, choses indispensables au praticien qui escompte le succès. Plus encore, nous sommes d'avis—et c'est là une opinion passée à l'état de lieu commun—que la faculté de contrôler, de titrer l'exactitude dans l'emploi de ces mêmes formules ainsi que celle des résultats obtenus en application, constitue une autre assise très importante dans l'édification de son éducation technique.

Or la science moderne, aidée du dessin, a conçue une méthode permettant de substituer la simple lecture par l'échelle d'un système d'abaques à l'élaboration des calculs numériques: c'est là le principe essentiel de la *nomographie*, communément appelée *calcul graphique*.

Cette nouvelle science d'application, nonobstant le vif intérêt qu'elle provoque, ne saurait ralentir la culture des mathématiques théoriques; elle deviendra plutôt, pour ces dernières, un appoint de vérification tout particulièrement précieux durant la période pleine d'incertitudes et d'hésitations des études primaires. C'est surtout en cela qu'elle intéresse directement l'apprenti soucieux de son avenir, ainsi que l'ouvrier chez qui une connaissance mal coordonnée ou insuffisante des données mathématiques fondamentales entrave le progrès.

Loin de nous proposer de couvrir entièrement le champ actuel de cette science toute moderne, nous voulons simplement indiquer en substance certains procédés dont elles dispose pour la vérification de la plupart des calculs de l'usine, et dont nous donnerons un bref exposé sous forme de problèmes gradués, mentionnant au passage les possibilités d'applications.

Problème 1. *Opérer graphiquement l'addition de deux quantités données* "a" et "b"

Solution: (Voir Fig. I).

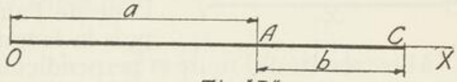


Fig. "I"

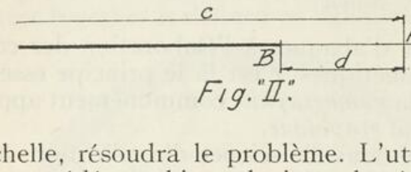
A une échelle convenablement choisie portons, bout à bout, et dans une même direction arbitraire "O X" les deux segments rectilignes qui correspondent aux quantités "a" et "b": la longueur totale résultante "*O C*", évaluée à la même échelle, donnera le résultat cherché.

Le même procédé servira aussi à établir la somme de plusieurs quantités entières, fractionnaires, décimales.....

Problème II. *Opérer graphiquement la différence de deux quantités données* "c" et "d".

Solution: (Voir Fig. II).

Sur une direction arbitrairement choisie "OX" portons—à une même échelle convenable—l'une des quantités données "c" suivant "OA", puis l'autre "d" en sens inverse suivant "AB": le segment différentiel résultant "OB", évalué à la même



échelle, résoudra le problème. L'utilité de ce procédé graphique devient plus évidente surtout dans le cas des nombres complexes décimaux ou fractionnaires.

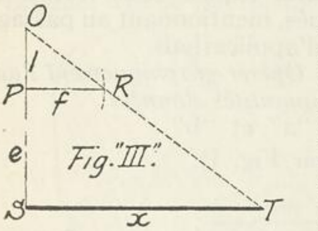
PROBLÈME IIIa. *Opérer graphiquement le produit de deux quantités données.*

Nous donnerons aux diverses solutions de ce problème la facture d'une proportion simple

$$\frac{X}{A} = \frac{B}{1}$$

nous basant sur le fait que la mesure d'une grandeur résulte de sa comparaison avec une autre prise pour unité, ce qui entraîne que l'inconnue cherchée est une quatrième proportionnelle à trois quantités données "A", "B", et l'unité.

Solution 1: Soient "e" et "f" (Voir Fig. III), les quantités données.



A une échelle convenablement choisie, traçons l'*unité* et la longueur "e" à partir d'un même point "0" et en recouvrement l'une de l'autre, puis la longueur "f" à l'extrémité de l'unité et perpendiculaire à cette dernière. Une parallèle à "f" issue de "s" rencontrera "O R" prolongée en "T". Deux triangles rectangles semblables "O P R" et O S T" seront ainsi déterminés, donnant la relation

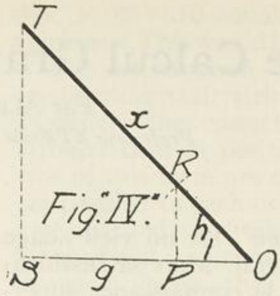
$$\frac{x}{f} = \frac{e}{1}$$

d'où $x \times 1 = e \times f.$

"x" évaluée à l'échelle usitée correspondra donc au produit cherché.

Solution 2: Soient "g" et "h" les nombres donnés (voir Fig. IV).

Ayant choisi l'unité de longueur traçons les segments rectilignes représentatifs de



l'*unité*, de "g" (ces deux derniers en recouvrement l'un de l'autre) et de "h" (la position de ce dernier ne sera déterminée qu'après avoir élevé une perpendiculaire "P R" à "OS"), tels que l'indique la graphique ci-contre, puis complétons les triangles rectangles semblables "O S T" et O P R" qui donnent la proportion

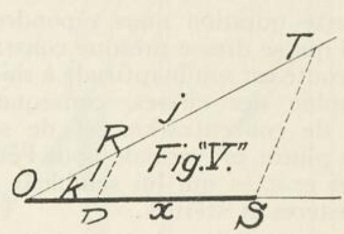
$$\frac{x}{h} = \frac{g}{1}$$

d'où $x \times 1 = g \times h$

Ici encore, "x" mesurée à la même échelle établira le produit demandé.

Contrairement au cas de la solution "I" qui est toujours réalisable, ce procédé-ci ne sera possible qu'à la condition $h > 1$.

Solution 3: Soient "j" et "k" les quantités imposées (voir Fig. V).



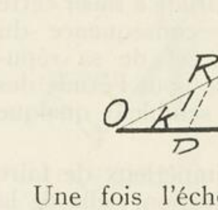
Une fois l'échelle choisie, traçons les segments linéaires correspondant aux nombres "1", "j" (ces deux derniers en recouvrement l'un de l'autre) et "k," dans des directions arbitraires convenables, tels que représentés, et complétons les deux triangles semblables quelconques "O S T" et "O P R" qui fournissent la relation

$$\frac{x}{k} = \frac{j}{1}$$

d'où $x \times 1 = k \times j$

"x" donnera encore, à la même échelle, le produit cherché.

Solution 4: Soient "m" et "n" les nombres donnés (voir Fig. VI).



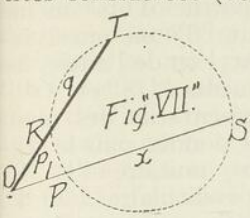
L'échelle étant déterminée traçons, bout à bout, les segments rectilignes "O S" et "O P" représentatifs des nombres "m" et "n", puis "O R" correspondant à l'*unité* et dans une direction appropriée. Si l'on décrit ensuite la circonférence de cercle qui passe par les trois points "P" "R" et "S", on aura alors deux cordes "P S" et "R T" qui se coupent en donnant la relation

$$\frac{x}{m} = \frac{n}{1}$$

d'où $x \times 1 = m \times n$

Le segment "x" évalué à l'échelle, correspondra au produit cherché.

Solution 5: Soient "p" et "q" les quantités considérées (voir Fig. VII).



Choisissons une échelle convenable, et à partir d'un même point "O" traçons le segment rectiligne unitaire "O P", puis "O R" et "O T" représentatifs des nombres "p" et "q" et en recouvrement l'un de l'autre. Si, maintenant, on décrit une circonférence de cercle passant par les trois points "P", "R" et "T", on se rappellera que les deux sécantes "O T" et "O S" issues du même point "O" fournissent l'équation

$$\frac{x}{q} = \frac{p}{1}$$

d'où $x \times 1 = p \times q.$

Le segment rectiligne "x" mesuré à l'échelle correspondra donc au produit demandé.

Les divers procédés employés dans la solution du *problème IIIa,* sont fort commodes pour le calcul de circonférences, de surfaces simples ou encore dans la vérification du partage parfois complexe de certaines quantités.

PROLÈME IIIb: Opérer graphiquement un produit de plusieurs facteurs.

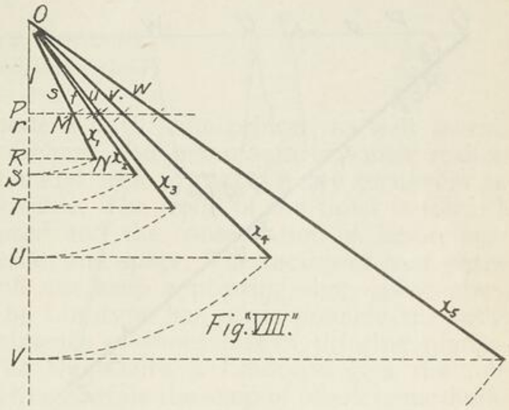
En d'autres termes, il s'agit ici de généraliser le *problème IIIa.*

Deux solutions sont fort en usage.

Solution 1: Soient "r", "s", "t", "u", "v" et "w" les facteurs donnés tels que l'on doit avoir

$$x = r \times s \times t \times u \times v \times w$$

A une échelle convenablement choisie (voir Fig. 8), on porte, à partir d'un même point "O" et en recouvrement l'un de l'autre, les segments "O R" et "O P" représentatifs des nombres "r" et "1", puis on trace en "P" une perpendiculaire à "O R". Enfin traçons à partir de "O" comme centre, avec une ouverture de compas "O M" représentative de "s" à l'échelle choisie, un arc de cercle qui donnera le point "M". La droite "O M" prolongée et la perpendiculaire "R N" à "O R" détermineront, par leur intersection, deux



triangles rectangles "O R N" et "O P M" semblables qui permettront d'écrire les rapports égaux

$$\frac{x_1}{s} = \frac{r}{1}$$

d'où $x_1 \times 1 = r \times s$

Si maintenant on imagine que "ON = x¹", tourne autour de "O" comme charnière pour se coucher en "O S", une construction semblable à la première (en y faisant intervenir la valeur "t") donnera

$$\frac{x_2}{t} = \frac{x_1}{1}$$

d'où $x_2 \times 1 = x_1 \times t = r \times s \times t.$

Par une série de constructions géométriques semblables, découlant toutes les unes des autres, on pourra faire les déductions suivantes:

$$\frac{x_3}{u} = \frac{x_2}{1}$$

d'où $x_3 \times 1 = x_2 \times u = r \times s \times t \times u;$

$$\frac{x_4}{v} = \frac{x_3}{1}$$

d'où $x_4 \times 1 = x_3 \times v = r \times s \times t \times u \times v;$

$$\frac{x_5}{w} = \frac{x_4}{1}$$

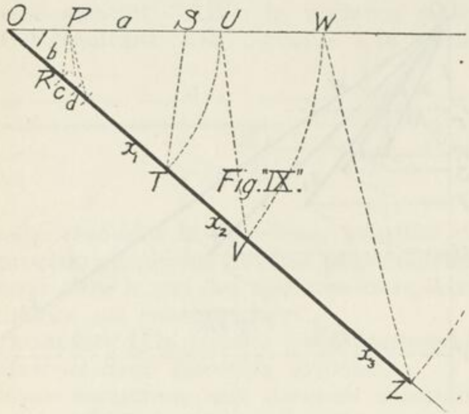
d'où $x_5 \times 1 = x_4 \times w = r \times s \times t \times u \times v \times w.$

Solution 2: Soient "a", "b", "c" et "d" les facteurs que l'on considère tels que l'on veut avoir

$$x = a \times b \times c \times d$$

(Voir Fig. IX).

Choisissons une échelle convenable et, à partir d'un même point "O", traçons en direction arbitraire mais appropriée les segments "O P" et "O S" représentatifs



de l'*unité* et du facteur "a" (en recouvrement l'un de l'autre), ainsi que le segment "O R" correspondant au facteur "b", puis complétons les triangles semblables quelconques "O P R" et "O S T" qui établiront la proportion.

$$\frac{x^{1}}{b} = \frac{a}{1}$$

d'où $x_1 \times 1 = a \times b$.

Alors on couchera $OT = x_1$ en "O U", et comme dans le cas de la solution "1" une série de constructions semblables subséquentes nous permettront d'écrire

$$\frac{x_2}{c} = \frac{x_1}{1}$$

d'où $x_2 \times 1 = x_1 \times c = a \times b \times c$;

$$\frac{x_3}{d} = \frac{x_2}{1}$$

d'où $x_3 \times 1 = x_2 \times d = a \times b \times c \times d$.

Les procédés en usage dans les solutions du *problème* IIIb sont de ces plus utiles pou la vérification des surfaces plutôt complexes (surtout dans le cas du cercle et de l'ellipse), des volumes, et de tout autre calcul impliquant l'élaboration du produit de plusieurs facteurs entiers, décimaux, fractionnaires, etc...

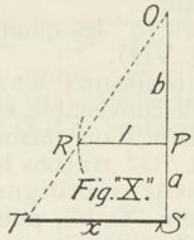
Problème IV : Opérer graphiquement le quotient de deux nombres donnés.

Tout comme dans le cas de la multiplication on fera appel au principe des proportions interprêtant comme comparaison à une unité choisie la mesure d'une grandeur considérée. L'inconnue cherchée sera, ici de même, une quatrième proportionnelle à trois quantités connues, et s'obtiendra par la relation

$$\frac{x}{1} = \frac{A}{B}$$

Trois solutions principales sont en usage.

Solution 1: Soient "a" et "b" les quantités dont on veut établir graphiquement le quotient (voir Fig. "X").

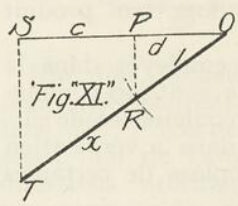


Choisissons une échelle convenable et traçons, à partir d'un même point "0" en recouvrement l'un de l'autre, les segments "OS" et "OP" représentatifs des nombres donnés puis le segment unitaire "P 'R' perpendiculaire à O P. Si l'on prolonge "O R" jusqu'à son intersection avec "S T" parallèle à "P R" les deux triangles rectangles semblables "OPR" et "O S T" nous permettront d'écrire

$$\frac{x}{1} = \frac{a}{b}$$

c'est-à-dire que le segment "x" mesuré à l'échelle établira le quotient cherché.

Solution 2: Soient "c" et "d" les nombres à diviser graphiquement l'un par l'autre (voir Fig. XI).

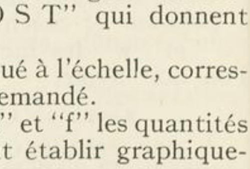


L'échelle étant choisie, opérons comme dans le cas précédent à partir d'un point "O" pour coucher les segments représentatifs de "c" et de "d" en "O S" et "O P". L'intersection de cette dernière avec un arc de circonférence décrit de "O B" comme centre et comme noyau permettra de compléter deux triangles rectangles semblables "O P R" et "O S T" qui donnent l'égalité de rapports.

Le segment "x" évalué à l'échelle, correspondra au quotient demandé.

Solution 3: Soient "e" et "f" les quantités imposées dont on veut établir graphiquement

$$x = \frac{e}{f}$$



(Voir Fig. XII).

A une échelle convenable traçons, à

(*Suite à la page 31*)

The Drama of the Linotype

Part II

By Edward Mott Woolley

(Reprinted from the American Printer)

THE Linotype has, indeed, turned the dreams of many a man into money. If the average yearly output of all the 55,000 Linotypes were set by hand, and the compositors' arms could be attached to automatic recording devices, a most amazing chart would result. If extended in a tangent, the line would go straight to the sun, and would curve around that fiery body and come back to earth. Or, to emphasize the point in another way, you could follow that line on more than two hundred round trips to the moon.

If you could gather all the Linotypes and put them side by side, you would have the most amazing printing office one could imagine, reaching more than sixty-two miles. If all of them together were put at work some morning on book composition they could flood the market by night with nearly 6,000 books. If you imagine Linotype machines doing acrobatic stunts, these 55,000 would make a column seventy miles high.

The Linotype holds within itself unknown possibilities for speed. No operator ever yet found its limit in a race against time, for, no matter how fast the operator worked, the machine was always ahead. Many extraordinary records have been established. One brilliant operator set 16,000 ems in an hour, which in plain English means about 5,500 words, or over two newspaper columns of six-point type. Another operator on a run of eight hours averaged 12,151 ems an hour. Ordinarily the average Linotype operator sets from six to seven times as much matter as a hand compositor, or from 5,000 to 7,000 ems per hour. Daily records have been made, however, in excess of this amount. In a year the usual Linotype operator composes a column of type 8,600 feet long.

The hand compositor will average perhaps 800 ems an hour. In the old-fashioned way the hand printer will distribute somewhere around 5,000 ems an hour, but the Linotype automatically distributes more than 16,000 ems in sixty minutes—and rarely, if ever, makes a mistake.

Time is the essence of success in these modern days. The printer, as well as the merchant and manufacturer, must realize this and seek to get as many turnovers as possible. The trend of the times is toward speed and the conservation of labor, material, and space. The tactics of past years will not keep a printing shop going now. The Linotype has made possible the very existence of thousands of printing plants. The shop with a Linotype gets the job through while the shop of obsolete methods is getting ready. Quick service to customers is the first consideration of business-building, and by increasing the number of sales the Linotype enables a shop to increase its earnings. Then, too, the Linotype enables the printer to meet unusual demands. He need not say to customers, "I can't do the job."

Yet when the Linotype was first put on the market it brought consternation to compositors. Naturally, they looked on it as a device to take away their living. Instead, it has immensely raised the plane of the printer. The old days of the journeyman typesetter, with his perennial quest for work, are gone. The Linotype instead of being his enemy is his best friend. It has led him up out of primitive things, and from scanty and irregular income, into what is perhaps the highest plane of labor today. The Linotype operator is in the limelight of artisanship. In brains and distinction he ranks with every other skilful worker. He is the intermediary between creative human brains and the Linotype—which, figuratively, is the brainy aristocrat of machines.

There are now 70,000 Linotype operators and machinists in the United States, and with the owners you have an army of 80,000 men. Their product goes into practically every home in the land, no matter whether English is spoken or some other language.

The Linotype serves all printers alike, big and little. In the composing rooms of the great dailies you find long batteries of these machines, and more than 6,000 printing shops in the United States alone have only one Linotype apiece. Hundreds of hand-composing shops change to the Linotype every year.

No matter whether a shop does everyday commercial printing or produces the most artistic and difficult work, the Linotype does it. Whether the printer sets ordinary reading matter or advertising, he is served by this machine—so nearly human.

It has taken possession of many an advertising department, where its range is from 5 to 60-point type.

Headline setting, and getting ads out on time, are now functions of the many-sided Linotype. The early inventors never contemplated such fields for it.

Recently the use of these machines enabled a shop to take four men from the ad room and place them in other departments of the composing room. Twelve tons of metal were released and 500 cases of type discarded, along with six type-racks. The space occupied was reduced one-half, and two men in a night were able to handle all the display for 210 columns of advertising.

All along the line this machine eliminates time and sidetracks disaster. For one thing, Linotype matter is never considered. One night the first page of a New York daily was pied on its way to the stereotypers, but in thirty-one minutes it was restored. Not a single reader suffered a delay in getting his paper. And the composing room devil who caused the accident was forgiven. In the old days his career in that particular shop would have been ended.

With the Linotype always printing from new slugs, make-ready is reduced almost beyond belief, and for the proofreader it dispenses with many time-honored hieroglyphics of the craft. It is impossible to get a letter upside down, and a wrong font seldom gets past the font-distinguisher.

In other directions, too, the Linotype has been the inspiration that has given the world scores of inventions for machines in the printing line. But the company has followed a policy not to use ideas until satisfactory arrangements are made with the inventors. It constantly calls for suggestions, and Linotype operators, machinists, and others are invited to submit ideas for improvements.

There is no department in any of the mechanical trades that is of such ultimate importance to the buyer as that of engineering and research. There is hardly a concern in the country that devotes so much time, spends so much money, and gives such a large proportion of its floor space and its supervision for experimental and development work. In this way there is being worked out a constant succession of practical improvements that effect operating advantages and reduce the cost of the Linotype's product.

And the company aims to contrive these improvements in such a way that they may be used on older models. In this service it stands unique.

Although Linotype-users may charge off a theoretical ten per cent. every year for depreciation, their machines may be in use fifteen or twenty years—because of innate stability and the use of these attachable improvements. In 1892 a large eastern newspaper installed a battery of Linotypes which rendered continuous service, three shifts daily, for twenty-four years. In the office, and in countless other establishments, the Linotype is known as the machine that lasts.

The Linotype has worked into every form of composition, including dictionaries, encyclopedias, catalogues, directories, editions de luxe, books, magazines, and tabular work of intricate kinds. In versatility it amazes us. In some shops you find Linotypes working patiently and correctly on great freight-rate sheets with so many columns of figures that your head swims; or you find a Linotype composing a comparative summary of costs—drawing the lines, filling in the totals, and doing the whole job with infinite neatness.

Nor does it balk at statistical charts that look like the skyline of a great city. In election time it works on ballots, and here you find the same expert results. In many printing offices in summer you see Linotypes rapidly working out the baseball scores, and accommodating themselves gracefully to the unplayed innings.

The more you look into the adaptability of this machine, the greater does your admiration become. With the aid of over 1,500 different faces it accepts without protest almost any special job. It works mathematical, algebrical, geometrical, and trigonometrical problems, using all the technical characters. You can make it do almost any sort of work that calls for unusual commercial characters, piece fractions, logotypes, Roman numerals, box rules, or reference marks of wide variety. It handles tariff, medical, ecclesiastical, astronomical, and similar composition.

Originally the Linotype's range of characters was limited to ninety, but printers speedily demanded more. From decrying the machine they began to grasp its possibilities. Then came the two-letter matrices, with 180 characters. By this time the printer's imagination was aroused, and the company evolved the two-magazine machine, bringing into use 560 characters. But still the printer was unsatisfied, and the company continued to measure up to the quickening market. It became possible to use 540 characters, and then 720, and today in the modern newspaper shop the text, heads, and advertisements may be set on the Linotype without changing the magazines.

As a linguist the Linotype has an astonishing capacity, for it speaks fifty languages. If you know how, you may converse with it in all the modern tongues of Europe, in Albanian, Arabic, Armenian, Burmese, Hebrew, Icelandic, Roumanian, Ruthenian, Servian, Slavic, Esperanto, Welsh, Bulgarian Estrangela, Nestorian, Jacobite, Portuguese, and so on.

You would scarcely expect to see Linotypes a thousand miles up the Amazon, almost on the equator, yet you will find twelve machines there, and some of them have been in operation for years—in a climate extraodinarily damp and trying. There are Linotypes, too, 1,100 miles up the Paraguay River from Buenos Aires; and in the mountains of Peru, more than 20,000 feet above the sea, Linotypes have been working faithfully through a series of years—in a wonderfully rarefied atmosphere. These abnormal climates are a severe test, indeed, and if the machines can be used successfully in such countries—and far from supply stations—they can be used anywhere.

In Brazil, Columbia, Bolivia, Chile, Venezuela, and British Guiana you find batteries of them; and elsewhere in South America. At the time this is written there are more than 2,000 Linotypes on the South American continent. There are several hundred in Central America, Mexico and the West Indies.

All across Siberia, withstanding the arctic cold, there is a string of them, and some are 6,000 miles from an agency or supply warehouse. Yet these machines run every day without inconvenience or delay, just as the Linotypes do in the cities of the United States or of England; and in various parts of the world such instances are repeated. Durability and simplicity of operation make these things possible.

Two Linotypes at Reykjavik, Iceland, are used daily in setting the newspaper "Logrjetta." Finland uses them also.

In Honolulu, Linotypes have been used more than twenty years. In 1910 in Alaska there were only nine men setting type—all by hand; today a score or more of newspapers in Alaska depend wholly on the Linotype.

In the Fiji Islands you will find them, too; and in the Philippines more than forty are operated. South Africa, Australia, and all those far countries have the Linotypes on every-day duty.

In Tokyo the Japan "Advertiser" is published in English, and the composition is done on Linotype machines by Japanese printers who do not know our language. They simply follow copy, and set about a galley an hour.

Almost anywhere you go the Linotype has gone ahead. If you could open the door of a certain printing office in Rangoon, India, the click of three machines, operated by natives and talking the language of the country, would greet you. You would hear the same cheerful sound, too, in Singapore Calcutta, Bombay, and Allahabad, the latter in the heart of India. One Linotype job, for instance, was to speak three languages at once, which it did in setting an English, Turkish and Armenian dictionary.

The Linotype is strong on diplomacy and court life. Long ago it secured its credentials to the inmost circles of almost every capital in the world. You will find it in the government printing offices in Washington, London, Ottawa, Rome, Madrid, Lisbon, Prague, The Hague, Athens, Sofiia, Calcutta, Rio de Janeiro, Santiago, Quito, Lima, Guatemala, Montevideo, Bogota, Pretoria, Tokyo, Manila, City of Mexico, Havana, Melbourne, Wellington, and Sydney. Nor do I attempt to give the full list.

Then the Linotype is used in state printing offices in every state of the Union.

The lingual abilities of the Linotype are many and curious. It is often necessary in printing shops to set up foreign-language composition not in line with their regular practice, and supplementary keyboards are placed on top of the ordinary ones. Thus Russian, for example, can be set on an English-speaking Linotype.

Just a little more of its ancient history. If there had never been a typewriter, there never would have been a Linotype. It was when the writing machine came along and began to be talked about, somewhere around 1876, that those five shorthand writers in Congress—Moore, Warburton, Clephane, Murphy, and Devine—were immensely interested. Their calling was a strenuous one. Each of the five would work perhaps an hour in the laborious longhand transcription.

One of these men—it is usually attributed to Moore, though Clephane also claimed it—conceived the idea of doing away altogether with the intermediate transcription and of inventing a machine that would set type direct from the notes. It was Moore, however, who really began to experiment, and among them the five contributed a few dollars a week out of their salaries—which ran around thirty dollars a week from the government. A little shop was established in Washington.

The primitive printing machine of Moore looked something like a typewriter. It had a cylinder bearing the characters, which were printed in lithographic ink on a strip of paper which was afterwards cut into lengths, arranged in the form of a page, and justified by cutting between the words and separating them. A transfer was then made to a lithographic stone, from which the print was made.

In this queer device, nevertheless, those shorthand men saw, even if vaguely, immense possibilities. The time was ripe, and they knew it, for a revolution in printing procedures.

Many of these first machines were built and used in Washington and New York. At the beginning the promoters thought they saw an immense fortune in the immediate future, but so many mechanical difficulties were encountered that they looked around for an expert to improve the device. They applied to a man named Hahl, in Baltimore, who was a maker of instruments of precision, such as chronometers. Hahl had no time for the work, but suggested his cousin, Ottmar Mergenthaler, who was a watchmaker. He was hired at five dollars a day and went to work in Hahl's shop, little dreaming that he was starting out on an enterprise destined to revolutionize the whole art of printing.

Mergenthaler, putting his very life into the work, speedily exhausted the small fund available, and fresh means had to be provided. The same thing was repeated over and over for years. If the investors could have foreseen all this they might never have undertaken it. Yet the fight, with all its heartbreaking disappointments, was alluring. They stayed in because Mergenthaler was always on the verge of some new and greater invention.

Yet Mergenthaler himself was completely discouraged at one stage of the enterprise. He abandoned all experiments and severed his connection with the embryo machine, declaring that the strain of bearing the blame was wearing him out. Clephane, however, and perhaps some of the others, refused to quit. The machine on which Mergenthaler had been working was removed from the Hahl shop in Baltimore to a little experimental place in Washington where for several years Clephane and his associates continued to attempt its development.

Meanwhile Mergenthaler, finding himself quite unable to let it alone, took up the problem on his own account in Baltimore, and finally produced important improvements. Then he returned to his former connections. It was about this time that the factory was established in better quarters in Washington, and additional capital secured.

In this brief outline no attempt is made to record events in their close sequence. The machine finally developed into one which indented the characters on a strip of paper-mache, which was cut up and justified in lines on a flat surface and then used for casting the type in metal.

From this machine were evolved others, all part of an evolution that resulted in the brass matrix. This was hailed with delight by the company, which by this time comprised many stockholders.

In the new machine each matrix dropped in response to a touch of the keys. It looked as if success had been reached, and the company went out after more money to build machines. This was a difficult job, but another one loomed even bigger—how to persuade the shop owners and printers to use this invention. In the newspaper field the traditions were centuries old. Not since the days of Gutenberg had any real change been made in the method of setting type.

In the face of all opposition and incredulity, a number of newspaper owners determined to make a trial. The leaders of this group were Whitelaw Reid, of the New York

Tribune; Melville E. Stone, and Victor F. Lawson, both of the Chicago Daily News; Walter N. Haldeman, of the Louisville Courier-Journal; Henry Smith, of the Chicago Inter-Ocean; W. H. Rand, of Rand, McNally & Company, Chicago; and Stilson Hutchins, of the Washington Post.

To Whitelaw Reid belongs the credit of inventing the name "Linotype", and of using the machine first for regular newspaper composition. His selection of the name was a dramatic contribution to the literature and nomenclature of industry.

But this so-called Blower machine was so imperfect that it fell far short of its mission. Two hundred of these machines were built, but the bulk of them could not be sold. Discouragement settled over the group of backers, and the project was all but abandoned. Then out of the gloom Mergenthaler and his co-workers produced a new Linotype. It showed such advantages that more capital was secured and the machine was adopted perforce. In time the older machines in use were replaced.

This was the dividing line between ancient and modern Linotype History. In 1890 the factory was moved to Brooklyn, where a little building now forming a tiny part of the present plant was rented, and in 1891 Philip T. Dodge became president of the company, which post he has continuously held.

But no sooner was a real composing machine attained than other inventors remembered they had been thinking along the same lines, and so began a fight to maintain the Linotype rights—well earned through these years of expense, work, and worry. The stockholders groaned under the burden of assessments, and many years elapsed before the company really did get over the top. From the beginning of the enterprise in Washington more than two million dollars was spent in perfecting the Linotype and building the organization before any of the stockholders got a dollar of profit.

To set type by machinery seems to have been a peculiarly baffling problem for inventors, for at least $50,000,000 has been lost in this country alone in unsuccessful attempts to develop such machines. Mark Twain was one famous loser in such an enterprise. He dropped all his fortune into it. But perhaps if he hadn't met with such misfortune the world would never have known some of his best books—written to pay off his debts and get on his feet again. It is said that the company in which he was interested built two machines that cost a million dollars apiece and proved unavailing.

Success is an elusive thing, hard to lay hold of, and it was not attained by the Mergenthaler Linotype Company until the value of the Linotype to the printer and the publisher and the public had become irresistible. And today the Linotype and the corporation back of it maintain their present relations to the printing and publishing interest of the entire world only because they represent the idealism of all business—the maximum of service.

Get a Hobby

Every one, no matter what his job is, should have some hobby. It is one of the best things in the world for both mental and physical health unless it is allowed to grow to such proportions that it rides us instead of our riding it. Most of us feel that we have to use about all the time and strength we have in getting a living, but there is practically no one who cannot find time during the week for some other type of work for change and relaxation.

To me there is nothing so enjoyable as gardening. I well realize that there are many to whom the growing of flowers or good vegetables seem like an awful chore, but healthful hobbies are not confined to digging in the dirt.

A little while ago an important official who has spent his life since early boyhood in railroading, beginning at a time when a day's work was often 16 hours long, said "If only I had learned to do something else once in a while, if it had been no more than to chase butterflies, I would be a great deal happier. I have spent every waking hour on my job, and now that I have caved and cannot do this, I have nothing to turn to which interests me in the slightest."

All of us are going to get old and slow up if we live long enough. Unless we have some hobby, which we enjoy—be it postage stamps, butterflies radio or garden—we are apt to find ourselves very much at a loss for a really enjoyable occupation.

Wholly apart from the happiness which some hobby will bring to us, there is the underlying sound medical basis for its development. We shall live longer and happier and do our work more efficiently if we, for a time every week, turn our minds or our muscles into some other channel than that in which they run while we are chasing the elusive dollar. It will help get the cobwebs out of the brain, lower the blood pressure and improve the disposition. Therefore, I strongly prescribe that, while you are well and before you have to, you develop a healthy hobby, even if it is nothing more than "chasing butterflies." Start today!

DISCONTENT

There are two kinds of discontent in this world: the discontent that works, and the discontent that wrings its hands. The first gets what it wants, and the second loses what it has. There's no cure for the first but success; and there's no cure at all for the second.—Gordon Graham.

Notions élémentaires de Mécanique [(1)]

Par JULES HALLÉ
Professeur à l'Ecole Technique de Québec

FORCES

PRINCIPE DE L'INERTIE.— L'inertie est la propriété qu'ont les corps de ne pouvoir d'eux-mêmes 1° passer de l'état de repos à l'état de mouvement, 2° modifier leur état de mouvement.

La première partie du principe est confirmée par l'observation directe; la 2ème partie peut se comprendre en observant par exemple qu'une bille lancée horizontalement conserve son mouvement d'autant plus longtemps que la surface de roulement est polie et que ce mouvement continuerait sans modifications s'il était possible de supprimer complètement les aspérités de la bille et du chemin de roulement ainsi que la résistance de l'air qui sont les causes de la diminution de vitesse et de l'arrêt final de la bille.

FORCES.— Les forces sont des causes capables de modifier l'état de repos ou de mouvement des corps. On appelle généralement force *motrice*, celle qui favorise ou tend à favoriser le mouvement d'un corps et force *résistante* celle qui s'oppose ou tend à s'opposer à son mouvement. Ainsi pour une automobile montant une côte, la force motrice sera fournir par le moteur, et les forces résistantes par les frottements des organes de la machine, la résistance au roulement, la résistance de l'air et la pesanteur du véhicule.

En mécanique, une force est complètement définie par sa direction, son sens, son intensité et son point d'application.

La *direction* est la ligne droite que suivrait le corps si, partant du repos, il cédait à la force.

Le *point d'application* est le point matériel où la force est directement appliquée.

Le *sens* qui se représente par une flèche indique sur la ligne de direction, lequel des deux chemins prendrait le point d'application s'il cédait à la force.

L'*intensité* est la grandeur de la force lorsqu'on la compare à une autre prise pour unité.

L'unité généralement adoptée est la livre, et pour mesurer directement l'intensité d'une force on se sert d'instruments appelés *dynamomètres*. Ceux-ci sont basés sur l'élasticité des lames métalliques et le plus simple est le peson qui peut être à lame ou à hélice.

Peson à lame: Il se compose d'une lame d'acier recourbée en forme de V (voir fig. 1) L'extrémité C est suspendue à un point fixe A par l'intermédiaire de la tige en arc A C; l'extrémité D est reliée au crochet B par l'intermédiaire de la tige B D.

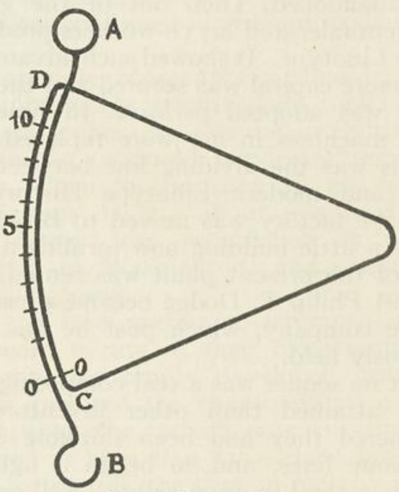


Fig. 1—Peson à lame.

On suspend au crochet B des poids de 1, 2, 3... 4 livres, pour une charge donnée la lame subit une certaine déformation et pour graduer le peson, il suffit de marquer sur la branche B D en face d'un repère O sur la branche A C, des divisions correspondant aux charges.

Peson à hélice: (voir fig. 2): Ce peson se compose d'un ressort hélicoïdal maintenu par une rondelle A à l'extrémité d'une tige B. Le ressort est enfermé dans une enveloppe cylindrique C portant un crochet D. Des poids variables étant accrochés en D, le ressort s'aplatit d'autant plus que les poids sont plus grands, et il suffit de repérer sur la tige les déformations correspondant à des charges connues.

Dans les deux systèmes de peson, les mêmes charges produisant les mêmes déformations, il suffira de lire directement

(1) Pour le commencement de cet article voir le numéro d'octobre, page 13.

sur les graduations pour connaître l'intensité des forces agissant sur les crochets.

Les deux appareils ont le défaut, à l'usage, de donner des indications inexactes par suite de l'altération de l'élasticité des ressorts.

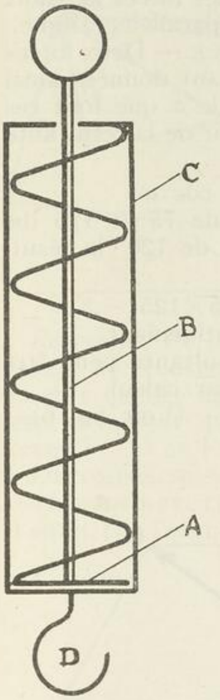


Fig. 2—Peson à hélice.

Représentation graphique.— Une force est représentée graphiquement (fig. 3) par un segment de droite terminé d'une part par un point A représentant le point d'application et par une pointe de flèche B indiquant le sens.

La longueur AB est portée proportionnellement à une échelle choisie arbitrairement; par exemple à une échelle de 1″ pour 100 livres, une force d'une intensité de 200 livres sera représentée par une longueur de 2″.

Composition et décomposition des forces.— On constate par expérience que lorsqu'un corps est soumis à plusieurs forces et par conséquent sollicité à se mouvoir dans plusieurs directions, il ne se déplace que dans une seule direction et on conçoit que l'on pourrait obtenir ce déplacement au moyen d'une seule force.

Cette force unique qui peut remplacer les autres forces (composantes) prend le nom de *résultante*.

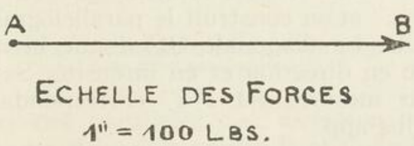


Fig. 3—Force de 200 lbs. Echelle des forces 1″ =100 lbs.

Déterminer la résultante de plusieurs forces est *composer* ces forces.

Inversement une force unique peut être remplacée par plusieurs autres produisant le même effet, et déterminer ces forces s'appelle *décomposer* une force en plusieurs autres.

Plusieurs forces agissant sur un corps peuvent être dans le même plan ou dans des plans différents; dans cette étude élémentaire on n'envisagera que des forces situées dans le même plan, et celles-ci peuvent être:

1° *De même direction.*
2° *Concourantes.*
5° *Parallèles.*

Forces de même direction. — Des forces de même direction peuvent être de même sens ou de sens contraire.

Lorsque des forces sont de même direction et de même sens, *leur résultante est égale à leur somme.*

Ainsi plusieurs enfants tirant sur la même corde avec des forces respectivement égales à 25, 35 et 40 lbs peuvent être remplacés par un homme tirant avec une force de

$$25+35+40=100 \text{ livres}$$

Si deux forces de même direction agissent en sens contraire *leur résultante est égale à leur différence et son sens est celui de la plus grande force.*

D'une manière générale on peut conclure que:

La résultante de plusieurs forces agissant dans deux sens opposés sur un même corps est égale à la différence entre la somme des forces agissant dans un sens et la somme des forces agissant dans l'autre et que son sens est celui de la plus grande somme.

Si deux forces agissant en sens contraire sont égales, leur résultante est nulle et ces deux forces se font équilibre.

On voit donc que lorsqu'une force agit sur un corps sans modifier son état de repos il y a équilibre entre deux forces: l'une d'elles est la force agissante, l'autre est une force égale et directement opposée qui est appelée la *réaction.*

Ainsi, lorsqu'un corps pesant est posé sur une table, la table réagit avec une force d'intensité égale au poids du corps; lorsqu'on tire un objet avec une corde, cet objet tire avec la même force sur la corde.

Forces concourantes.— Lorsqu'un corps en équilibre est parfaitement rigide, on peut transporter le point d'application d'une force agissante sur le corps, en un point quelconque de sa direction, (voir fig. 4).

Les forces F′ et F² agissant sur le corps rigide A pourront être déplacées le long de leur ligne de direction et si elles sont dans un même plan, deviendront *concourantes* en B et pourront être remplacées par F′ et F^2 ayant toutes deux leur point d'application en B.

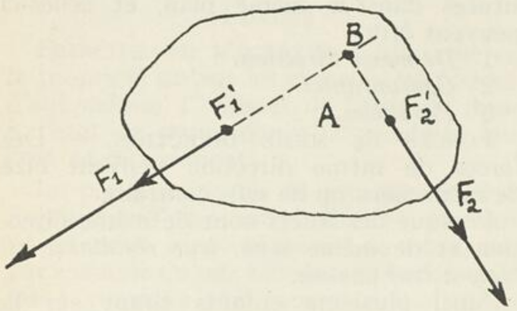


Fig. 4

PRINCIPE.— *La résultante de deux forces concourantes est représentée en grandeur et en direction par la diagonale du parallélogramme construit sur ces deux forces.*

VÉRIFICATION EXPÉRIMENTALE.— Ce principe se vérifie expérimentalement au moyen de l'appareil ci-dessous (fig. 5).

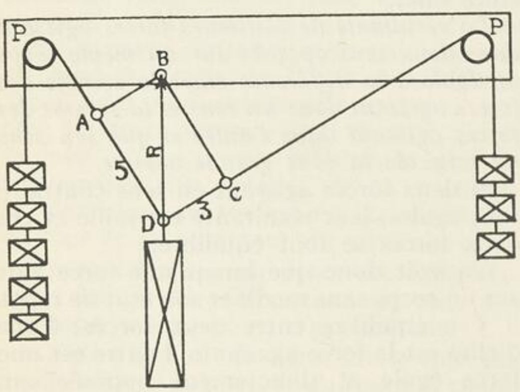


Fig. 5—Détermination expérimentale de la résultante de 2 forces concourantes.

Cet appareil est composé d'un parallélogramme articulé A B C D , aux extrémités A et C duquel sont attachées des cordes qui passent sur des poulies P et P′. Le parallélogramme peut tourner autour du point B qui est fixe. Si l'on accroche aux extrémités des cordes des poids proportionnels aux longueurs des côtés A D et C D on constate que:

1° *Le point D se déplace suivant la droite verticale B D* (direction de la résultante).

2° *pour que le point D ne bouge plus, il faut suspendre en D un poids qui est lui même proportionnel à la longueur de la diagonale B D.*

Le système étant en équilibre, le poids suspendu en D représente l'intensité d'une force directement opposée et d'intensité égale à la résultante R des forces agissant aux extrémités A et C du parallélogramme.

SOLUTION MATHÉMATIQUE.— Deux forces concourantes F′ et F^2 étant données ainsi que la grandeur de l'angle a que font ces forces entre elles, la valeur de la résultante est:

$$R=\sqrt{F_1^2+F_2^2+2F_1F^2 \cos a}$$

Exemple: Si 2 forces de 75 et 125 lbs font entre elles un angle de 120° la résultante a pour valeur

$$R=\sqrt{75^2+125^2+2\times 75\times 125(-.5)}$$

R = 109 lbs approximativement.

La direction de la résultante peut être également déterminée par calcul.

SOLUTION GRAPHIQUE.— (Voir fig. 6)—

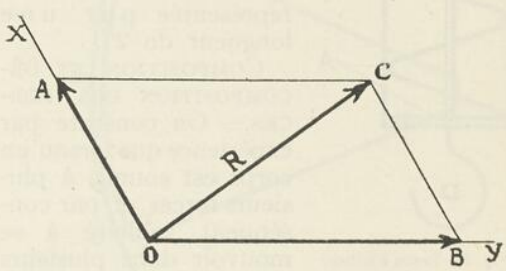


Fig. 6—Détermination graphique de la résultante de 2 forces concourantes.

Généralement on emploie la méthode graphique. Pour composer les forces données dans l'exemple précédent, on trace les lignes ox et oy faisant entre elles un angle de 120° En adoptant l'échelle des forces $\frac{1}{8}''$ = 10 lbs, on portera sur ox et oty des longueurs OA et OB respectivement égales à $\frac{15}{16}''$ et $1\frac{9}{16}''$ et on construit le parallélogramme OACB. La diagonale OC donne la résultante en direction et en intensité. Sa longueur mesurée est $1\frac{3}{8}''$ correspondant à 110 lbs app.

Pour trouver la résultante de plusieurs forces concourantes, on procède en composant la résultante de deux forces avec une troisième force, et ensuite la nouvelle résultante avec une autre force et ainsi de suite jusqu'à ce toutes les forces aient été composées.

Exemple: Soit à composer les forces F′ F^2, F^3 et F^4 (voir fig. 7).

R' est la résultante des forces F' et F^2; R^2 est la résultante de R^1 et F^3 et enfin R la résultante de R^2 et F^4 est la résultante des forces F^1, F^2, F^3 et F^4.

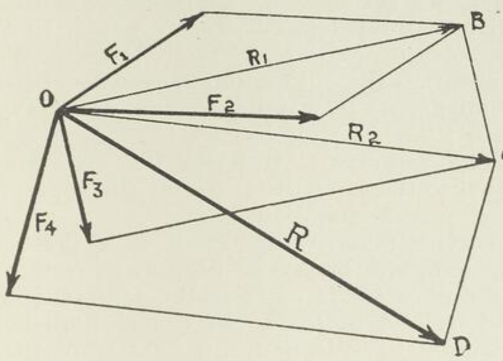


Fig. 7

Remarque: Le polygone fermée OABCD peut être construit directement si l'on observe que les lignes AB, BC et CD sont respectivement parallèles et égales aux forces F^2, F^3 et F^4.

DÉCOMPOSITION D'UNE FORCE EN DEUX AUTRES DE DIRECTIONS DONNÉES. (voir fig. 8 Il suffit par l'extrémité A de la force F de

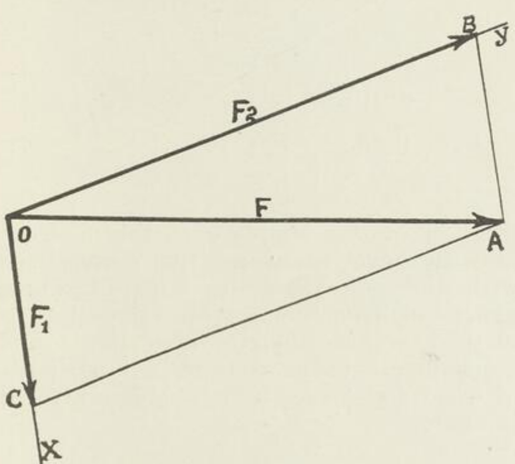


Fig. 8—Décomposition d'une force en 2 autres de directions données.

mener des parallèles aux directions données ox et oy. Les points B et C limitent les forces F^1 et F^2 pui sont les composantes cherchées.

Remarque: Lorsqu'il y a plus de deux directions données, le problème a une quantité infinie de solutions.

VARIATION DE LA RÉSULTANTE DE DEUX FORCES CONCOURANTES, FAISANT UN ANGLE VARIABLE (voir fig. 9).— L'angle des forces peut varier de 0° (forces de même direction et de même sens) à 180° (forces de même direction et de sens contraire). En déterminant graphiquement ou algébriquement les valeurs de la résultante on peut observer que pour

$$\alpha = 0^\circ \text{ on a } R = F^1 + F^2$$
$$0^\circ < \alpha < 90^\circ \text{ on a } F^1 - F^2 < R < F^2 + F_1$$
$$\alpha = 90^\circ \text{ on a } R = \sqrt{F_1^2 + F_2^2}$$
$$90^\circ < \times < 180^\circ \text{ on a } F^1 - F^2 < R < \sqrt{F^2_1 + F^2_2}$$
$$\alpha = 180^\circ \text{ on a } R = F^1 - F^2$$

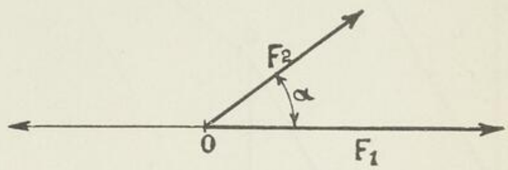


Fig. 9

APPLICATIONS.— Dans le calcul des machines, des charpentes, etc., on a souvent à effectuer des compositions et des décompositions de forces.

Exemple: Dans une machine à vapeur indiquée schématiquement sur le croquis ci-dessous, déterminer la pression sur les glissières lorsque la bielle est dans la position représentée, si la pression sur le piston est de 1000 lbs (voir fig. 10).

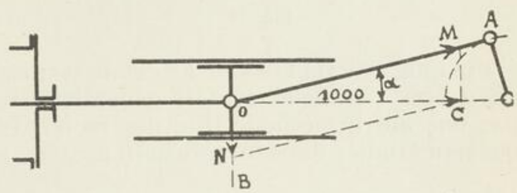


Fig. 10

Il suffit de décomposer la force OC suivant les deux directions OA et OB.
OM donne à l'échelle la poussée sur la bielle et ON donne la pression sur les glissières.

On peut se rendre compte d'après la figure que pour une même force agissante sur le piston la pression sur les glissières diminuera avec l'angle α.

Exemple: Dans la grue représentée schématiquement ci-dessous. Quelles sont les forces existant dans les membres AB et BC lorsqu'un poids de 10 tonnes est soulevé? (voir fig. 11).

La construction de parallélogramme des forces ODEF montre qu'une force de 13.3 t tire sur AB et qu'une force de 20.8 t pousse sur BC. On dit que AB travaille en tension et BC en compression.

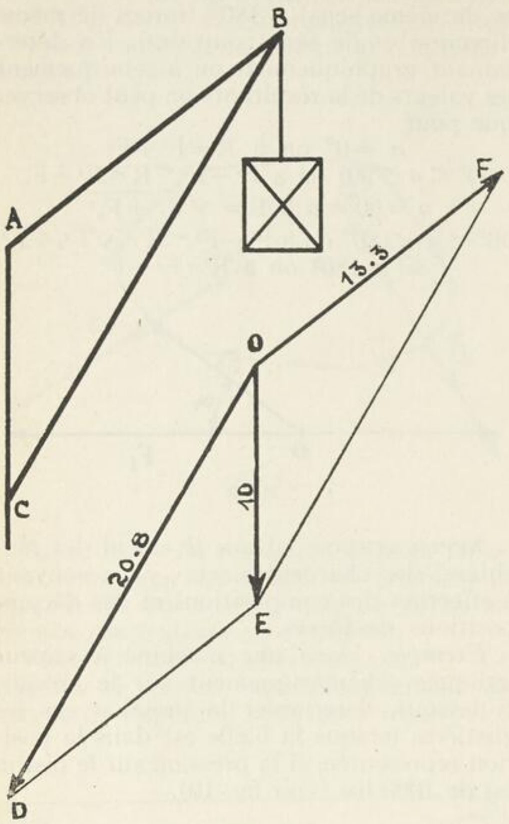


Fig. 11

Forces parallèles.— La composition des forces parallèles se fait généralement par une autre méthode dite des moments qui sera étudiée dans un prochain article.

Colle pour Verre

Le collage du verre est difficile à bien obtenir, surtout s'il s'agit de matières devant résister à l'eau, à l'alcool, à l'éther, comme c'est le cas, par exemple, pour coller contre leur garniture les deux plaques d'une cuvette pour projections photographiques ou examen microscopique. On obtient d'excellents résultats avec une solution composée de:

Acétate de cellulose.......................... 5 gr.
Tétrachloréthane..............................100 gr.
Alcool Méthylique............................ 10 gr.

On étend la colle sur chacune des deux surfaces à réunir, on fait adhérer en pressant pendant très longtemps, jusqu'à parfaite dessication de la colle. Les objets en effet ne doivent être employés qu'après disparition complète du dissolvant. Deux plaques de verre ainsi réunies peuvent rester immergées pendant plusieurs heures dans l'alcool ou dans l'éther sans que soit compromise la solidité de leur jonction.

Female Patient: "What shall I do for water on the knee, Doctor?"
Doctor: "Wear pumps."

Stair Building

(*concluded from page 6*)

The elevation of the stringer may then be drawn through the intersections of the vertical projections A2′ 3. 3′ 4 4′ etc., and the lines of steps M N O P. Draw X Y tangent to the outline of stringer and perpendicular to it. From 1′ 2′ 3′ 4′ etc. draw lines 1″ B′. 3′ K′. 4′ l′ etc.

The distances 1″ B, 3′ K, 4′ l′ etc., are equal to the same distances 1B, 3k, 4l, etc. as shown on the plan.

Having found the points B′ 2′ k′ l′ etc., the template may now be drawn. A thin piece of wood is cut out the same shape and is used to mark out the stuff to be sawn off as shown in Fig. 13. Note the

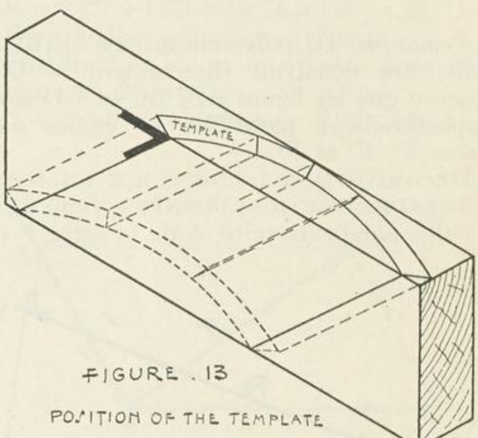


FIGURE. 13
POSITION OF THE TEMPLATE TO SHAPE THE HALF CYLINDER

position of the template in this figure—also the bevel whose position corresponds with the one shown in Fig. 12. These figures explain themselves. They show a method which though very simple and quick in execution, requires a large piece of wood and leaves a lot of waste after it is made.

HOSE FOR ANGELS

The sculptor had just finished his model of an angel, and one of his numerous friends had called in to see it, and at he same time give a little friendly criticism.

"I say," he said, "angels don't wear silk stockings. Did you ever see an angel in the high-heeled shoes and silk stockings?"

"Did you ever see one without them?" came the prompt question.

She: "I want to get a nice easy chair for my husband, please."
He: "Morris?"
She: "No, Jacob."

Special Devices Used In Conjunction With Machine-Tools

By G. Berthiaume
Graduate Montreal Technical School

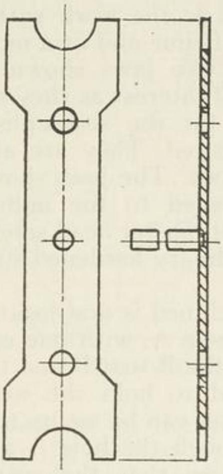
Machine-Tools.— It is with machine-tools that all other machinery is produced. The standard tools of the modern shop, lathes, drills, planers, shapers, millers, boring mills, grinders, etc., are all called upon to contribute their share to further economic modern manufacturing.

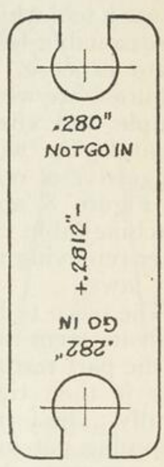
In order that the designer may be capable of designing a machine or tool which will meet modern requirements, he must first of all be thoroughly capable and familiar with the details of various lines of manufacture in which his design is to be employed. A theoretical and practical knowledge of the properties of all materials, must be possessed by the man who wishes to accomplish anything in tool design, before he can hope to solve the innumerable problems which will confront him.

Machine Operations.— A list of the most important operations employed in the working of metals may be enumerated as follows: forging, pressing, rolling, punching shearing, turning, drilling, tapping, planing milling, grinding, etc. The design and construction of drill-jigs and fixtures for machine-tools for modern manufacturing is found necessary because of the tremendous output of duplicate machine parts.

The various types of tools which are in use to-day for the cheap and accurate production of duplicate parts, consist of dies, templets, gauges, chuck or vise jaws, jig fixtures, jig cradles, chairs etc., and are mostly used in working and cutting metal parts which have been previously roughly formed by the process of rolling, drawing, forging or casting.

Templets.— Templets are tools made from flat pieces of metal, which are used to lay upon surfaces, and are located by the eye, fingers or pins, etc., so that certain edges of the templet, outside or inside, may be used as a guide for scribing outlines of them on the surfaces of the work, the outlines to serve as guides for drilling holes or for forming the outer or inner edges of the part to the external or internal outlines of the templet. The templet can be used either as a filing, shaping or planing jig, as the case may be. Figure 1 shows a die templet used by the blacksmith in the manufacture of sheet material cutting dies.





F.G. 1—Die Templet   Fig. 2—Snap Limit gauge

Snap Limit Gauges.— For many classes of work, the snap gauge may be used to

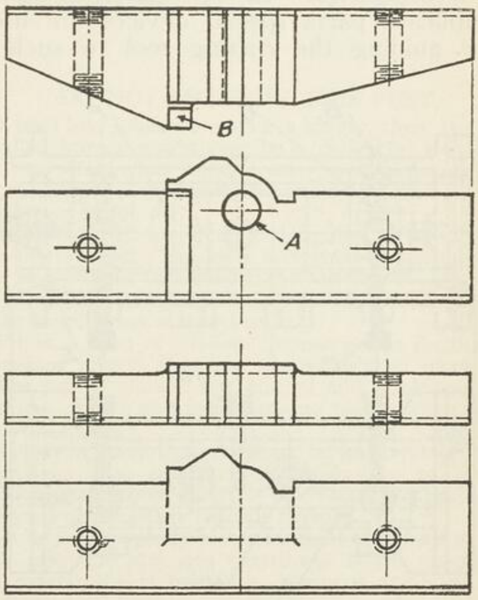


Fig. 3—Milling Vise Jaws

advantage as a limit gauge. It may be formed with an opening at each end, as shown in Figure 2. It is a good idea to make the ends of the gauge of different shape, in order to make a distinction between the large and small opening. Gauges can be designed double-ended, so that the work may be gauged without reversing, thus effecting a saving of time.

Milling Vise Jaws.— In the machining of levers, rockers which are fulcrumed on their stem and are to be form-milled on one or many sides, it is found advisable to use a tool which will do the work within a reasonable length of time and at a moderate expense. The vise jaws shown in Figure 3 are worthy of interest as they are simple and effective for the accomplishment of the work desired. They are also suggestive of other work. The jaws shown in Figure 3 are fastened to the milling machine table vise with filister head screws after removing the ordinary hardened steel flat jaws.

The piece to be machined is first located with its stem in the hole A, with one end of the part resting on the B seat B and the vise is then tightened to hold the work rigidly. The form cutter can be set up to a step-plug passing through the hole A and the operator should see that the cutter is running on the opposite side of the piece in order to take away any tendency to spring and thus produce accurate work rapidly.

Drilling-Jigs.— In the manufacture of duplicate parts special devices are used for guiding the cutting tool in such a manner that the work produced by them becomes identical, in all essential features, independent of the skill of the operator. Such devices are commonly called "jigs." They are used chiefly for the production of holes of circular cross-section by drilling and reaming operations or by both in conjunction and are also used occasionally for guiding taps, taper reamers, centering drills, counter-bores or other tools.

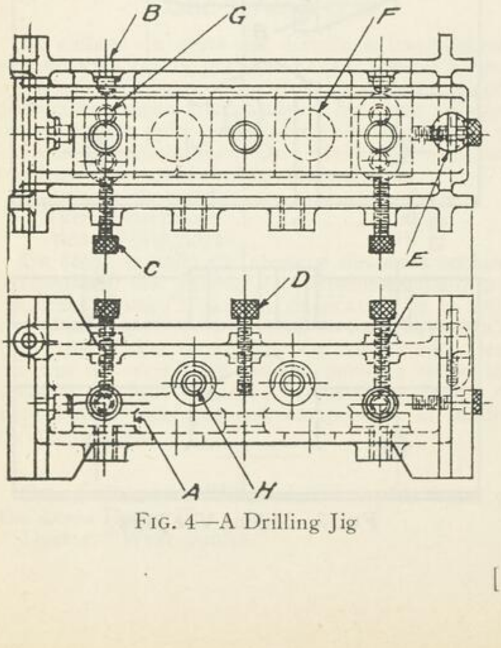


FIG. 4—A Drilling Jig

Figure 4 shows a drill jig in which a part indicated by dot and dash lines containing six holes to be drilled and two to be reamed, is located on three hardened steel seats *A*. Its surface having been previously milled, it is set against three jig buttons B and is held in place by the three thumb set screws *C*, which are screwed in the body of the jig and by three set screws *D* passing through the cover. The cover of this jig is hinged on one end and clamped with a quarter turn thumb screw *E* at the other end and is designed to hold the work down against the seats. Straps might have been used to clamp the work instead of a cover. Holes may be drilled and reamed through the cover into the piece, if provided with the necessary lining and slip bushings. As four holes have to be drilled from the bottom of the jig, two bosses are provided and four lining bushings *G* are driven into the casting. Two other bosses are cast on the side of the jig, to receive two lining bushings *H* in which are placed drill and reaming bushings. The reader may observe that two openings *F* have been made in the bottom of the casting, which are intended for the escape of chips and dirt.

Milling Fixtures.— As in the drilling-jigs, in making milling fixtures for machinery and duplication of interchangeable machine parts a number of obstacles must be overcomed. There are of course, a number of practical points in their design and construction which are absolutely essential for their successful operation.

If the milling machine is most suitable for the work to be done, the following points must be considered, after the shape and type of fixture has been determined: the surface on which the pieces are to be located; the devices for fastening the work, and, the most practical way of presenting the surface to be machined to the cutter.

The milling fixture shown in Figure 5 consists of a base on which are provided two rigid tongues *A* and slots *B* for holding on the machine table. The work is located in a hollow seat *C* and is fastened between a strap *D* which is held by the collar screw *E* and a flat hardened and ground seat *F*. The latter is held in place with the seat *C* by dowel pins and filister head screws passing through them. To prevent the strap from turning when the screw *E* is rotated in a clockwise direction, a pin *G* is inserted. The cutter or cutters are set

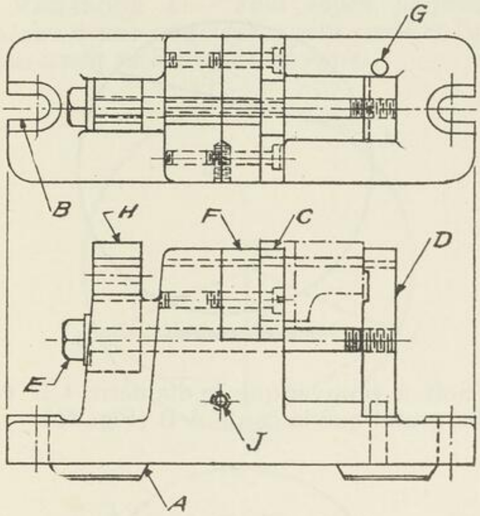


FIG. 5—Milling Fixture

to a ground detachable block *H*, fitted in a slot, and removed before the cutters are put in operation. A drilled and tapped hole is added in the body of the fixture, to permit the fastening of the set block to it, when the fixture is turned over to the tool clerk.

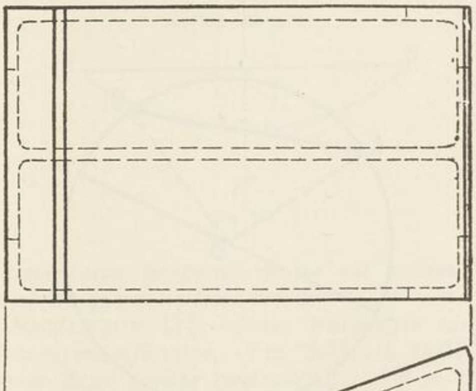


FIG. 6—Drilling Jig Cradel

Drill Jig Cradles.— It is sometimes desirable to drill holes in the work which are not parallel with the axes of the other holes in the jig. Whenever this is the case, a cradle such as shown in Figure 6 is used to support the jig at the given angle. The operation is then carried on with the same tools as in the ordinary jig, because the angle of the cradle corresponds with the angle of the non-parallel holes in the jig.

Drill Jig Chairs.— There is an advantage in using a chair with a heavy jig, because

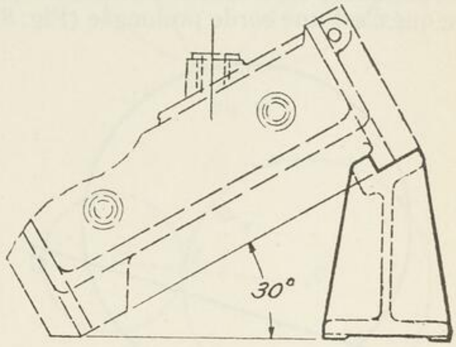


FIG. 7—Drill Jig on Chair

on account of the large dimensions of a heavy jig a very heavy cradle would be required. A jig of this kind with chair is shown in Figure 7. Naturally the jig in this case must be provided with feet; that is, the corners must be milled to form same angle as that of the hole which is to be drilled throught the jig.

DO NOT MISNAME THIS PEST

If jests and jokes were always kindly, then what is called humor would ever be a delightful thing; but too often what masquerades as a pleasantry is something quite different from what is commonly understood to be wit.

Banter is often a ridicule in disguise, a jeer or a gibe is frequently put over as sportive waggery. Too many times tomfoolery, the monkey-shines of the jovial joker, are attained by the embarrassment of the humiliation of another.

Wit is a form of wisdom, humor is the faculty of making merry, of seeing the mirthful or incongruous side of things; but unkind and unpleasant practices of jest and joke have no place either in wit or humor.

May we be saved from the practical joker, the rude jester who is no respecter of persons or things, the individual whose gaiety is the result of a brutal disregard of the other fellow's feelings.

Let us put this pesky pest in his right classification; don't misname him and contribute to his vanity and conceit; he is neither a humorist nor a wit, but a cruel torment.

Les principales Notions de la Géométrie*

Par Paul Cadotte
Professeur à l'Ecole Technique de Montréal

IV.—La Circonférence

Nous avons déjà examiné quelques propriétés de la circonférence dans la première leçon. Complétons, si vous le voulez bien, ces quelques définitions:

Une *sécante* est une droite qui coupe la circonférence; en d'autres termes, on peut dire que c'est une corde prolongée (Fig. 80).

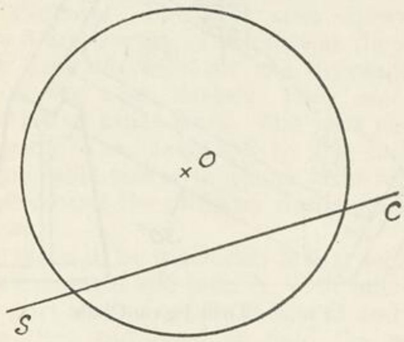


Fig. 80—La sécante SC

Une *tangente* est une droite qui n'a qu'un point de contact avec la circonférence (Fig. 81). Lorsqu'on trace une corde dans

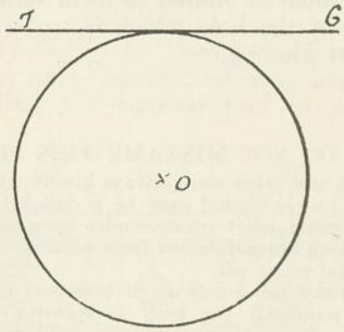


Fig. 81—La tangente TG

une circonférence, cette corde divise le cercle en deux parties qu'on appelle "segments". (Fig. 82).

On appelle *segment* la surface comprise entre une corde et l'arc qu'elle soutend.

Le *secteur* est la partie du cercle compris entre l'arc et les deux rayons aboutissant aux extrémités de cet arc (Fig. 83).

Théorème:—*Le diamètre est la plus grande corde de la circonférence.*

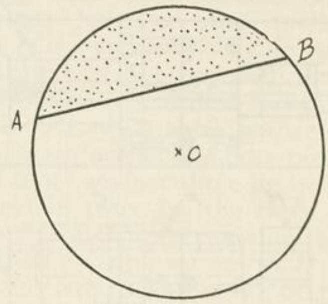


Fig. 82—Segment

Soit à prouver que le diamètre CD est plus grand que la corde A B (Fig. 84).

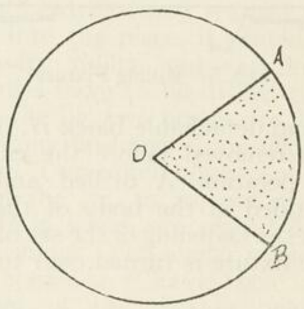


Fig. 83—Secteur

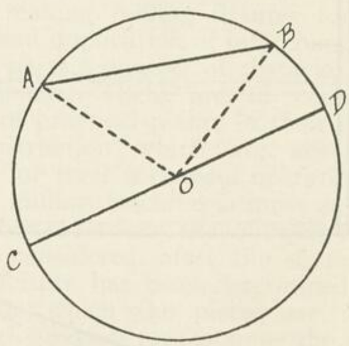


Fig. 84

Pour prouver ceci il suffit de savoir que tout diamètre vaut deux rayons. Ce diamètre C O D ou C D égale donc la ligne A O B formée de deux rayons (Fig. 84). Si donc je prouve que cette ligne A O B

---

*La première leçon a paru en septembre, et la seconde en octobre, la troisième en novembre.

est plus grande que la corde considérée A B j'aurai prouvé par le fait même que le diamètre C D est plus grand que la corde A B. Or le plus court chemin d'un point à un autre est une ligne droite. Donc A B est plus court que A O B et par conséquent plus court que C D, l'égal de A O B.

REMARQUE I :—"*Tout rayon perpendiculaire à une corde divise cette corde et l'arc sous-tendu en deux parties égales.*"

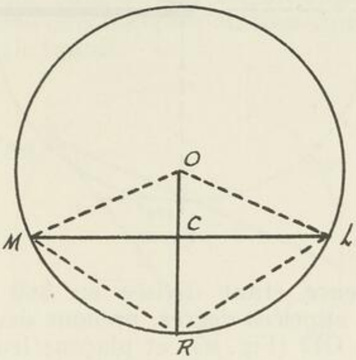


Fig. 85

Soit le rayon O R (Fig. 85) perpendiculaire à la corde M L; ce rayon passe au point C, milieu de la corde M L et au point R, milieu de l'arc M R L.

REMARQUE II :—"*Pour diviser un arc en deux parties égales,*" (Fig. 86), *il suffit*

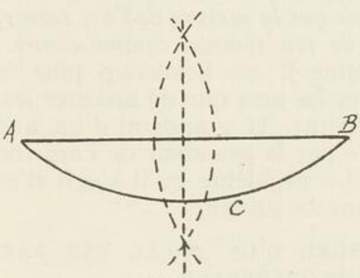


Fig. 86

d'élever une perpendiculaire au milieu de la corde qui sous-tend cet arc.

REMARQUE III :—*Pour trouver le centre d'une circonférence,* (Fig. 87), *il suffit de tracer deux cordes quelconques, AB et CD, et d'élever une perpendiculaire au milieu de chacune de ces cordes. Leur point de rencontre O nous donne le centre de la circonférence.*

DÉFINITIONS :—Deux *circonférences tangentes* sont des circonférences qui n'ont qu'un seul point de commun. Ce point commun à deux circonférences tangentes est appelé *point de contact* ou *point de tangence.*

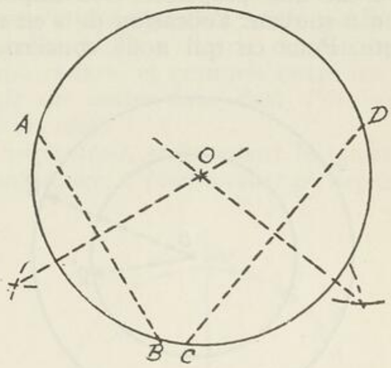


Fig. 87

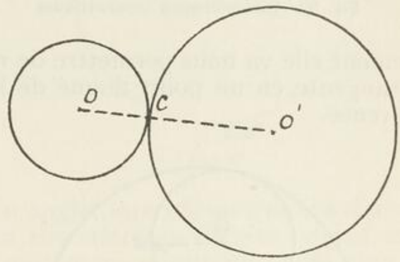


Fig. 88—Circonférences tangentes extérieurement

Deux circonférences peuvent être tangentes extérieurement (Fig. 88), ou tangentes intérieurement (Fig. 89).

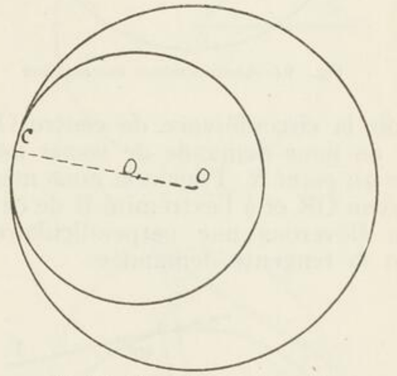


Fig. 89—Circonférences tangentes intérieurement

Lorsque deux circonférences sont tangentes, le point de contact C est toujours sur la ligne des centres O O[1].

Deux circonférences ayant le même centre sont dites *concentriques* (Fig. 90).

Si deux circonférences n'ont pas le même centre elles sont *excentriques.* (Fig. 91).

TANGENTE :—*La tangente à la circonfé-*

rence est toujours perpendiculaire à l'extrémité du rayon aboutissant au point de contact. C'est une propriété très importante et l'on a souvent l'occasion de s'en rendre compte. Pour ce qui nous concerne pré-

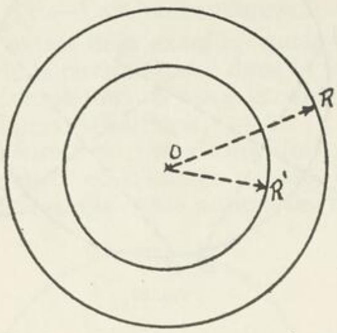


Fig. 90—Circonférences concentriques

sentement elle va nous permettre de mener une tangente en un point donné de la circonférence.

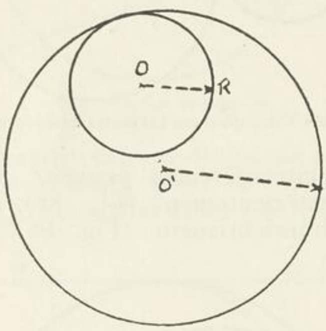


Fig. 91—Circonférences excentriques

Soit la circonférence de centre O (Fig. 92); on nous demande de *mener une tangente au point R.* Pour cela nous mènerons le rayon OR et à l'extrémité R de ce rayon nous élèverons une perpendiculaire RT. C'est la tengente demandée.

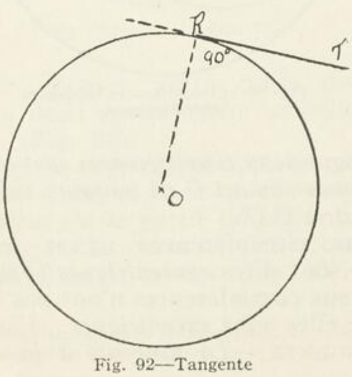


Fig. 92—Tangente

MESURE DES ANGLES:

On a vu que pour mesurer un angle il fallait mesurer l'arc correspondant. La cir-

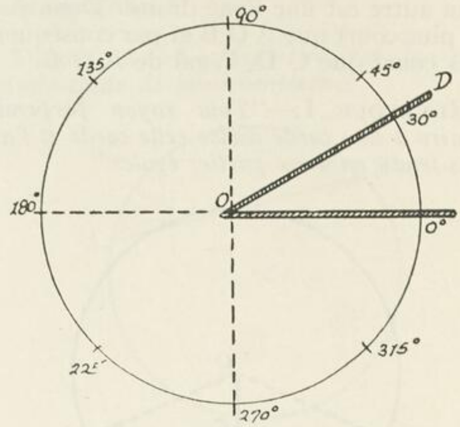


Fig. 93

conférence étant divisée en 360 parties égales appelées degrés, prenons deux tiges OA et OD (Fig. 93) et plaçons leur point de rencontre au centre O de la circonférence. La tige OA restant fixe dans la direction du 0°, si l'on fait tourner l'autre tige OD sur la circonférence, on voit très bien que la grandeur de l'angle varie avec l'arc AD compris entre ses côtés. Lorsque cet arc devient double, triple, etc., l'angle AOD, lui aussi devient double, triple, etc.

C'est pourquoi la mesure d'un angle est la même que la mesure de l'arc correspondant décrit de son sommet comme centre.

Comme il est beaucoup plus facile de mesurer les arcs que de mesurer les angles, dorénavant, la grandeur d'un angle sera donnée par la grandeur de l'arc correspondant. Le problème qu'il s'agit d'examiner est donc le suivant:

MESURE D'UN ANGLE PAR RAPPORT A UNE CIRCONFÉRENCE.

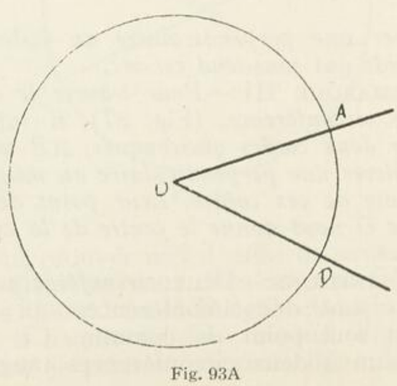


Fig. 93A

On peut considérer quatre cas représentés par les Figures 93, 94, 95 et 96. Ces quatre cas sont fournis par les différentes positions que peut occuper le sommet d'un angle par rapport à la circonférence.

1er cas:—Le sommet S de l'angle est sur le centre de la circonférence (Fig. 93). Dans ce cas l'angle ASD est appelé *angle au centre.*

2e cas:—Le sommet S de l'angle est sur la circonférence même (Fig. 94). Nous dirons alors que l'angle ASD est un *angle inscrit* dans une circonférence ou tout simplement un angle inscrit.

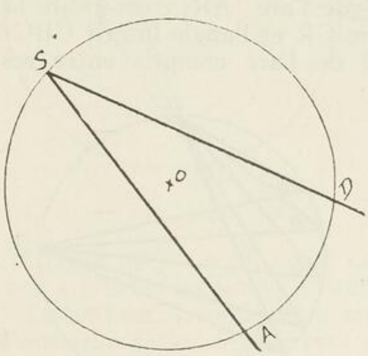


Fig. 94

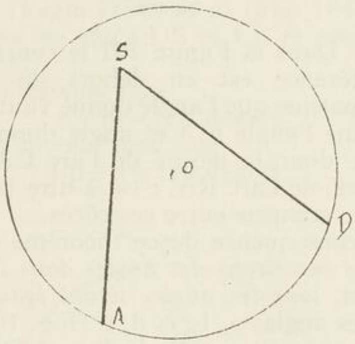


Fig. 95

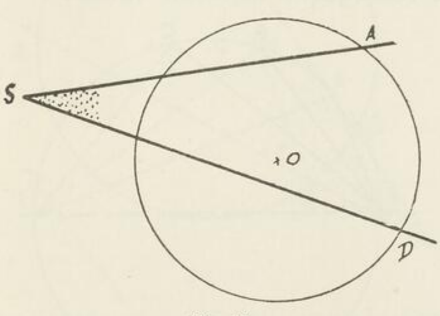


Fig. 96

3e cas:—Le sommet S est à l'intérieur de la circonférence, n'importe où (Fig. 95).

4e cas:—Le sommet S est à l'extérieur de la circonférence (Fig. 96).

I. Valeur de l'angle au centre: Comme la mesure d'un angle est la même que celle de l'arc décrit de son sommet comme centre, et compris entre ses côtés, l'*angle au centre vaut donc l'arc compris entre ses côtés.*

L'angle droit, embrassant le quart de la circonférence, *a pour mesure 90 degrés* (Fig. 97).

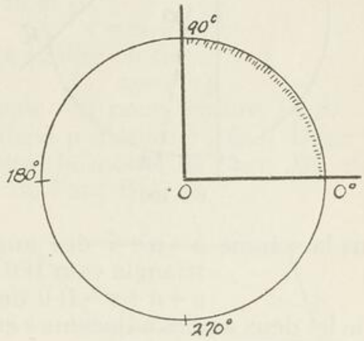


Fig. 97

Un angle, interceptant moins d'un quart de la circonférence décrite de son sommet comme centre, serait un angle aigu, (Fig. 98).

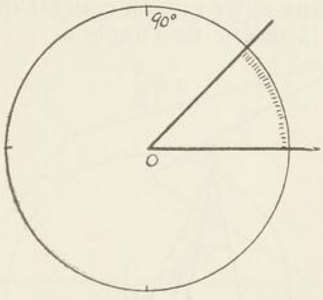


Fig. 98

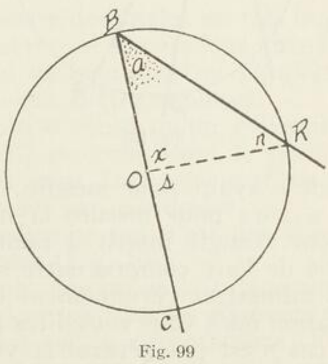


Fig. 99

II. Valeur de l'angle inscrit: Théorème:—*L'angle inscrit a pour mesure la* *moitié de l'arc compris entre ses côtés.* Soit a un angle inscrit dont un côté BC passe par le centre (Fig. 99). Si l'on mène le rayon OR, on forme un triangle isocèle et les angles a et n sont égaux.

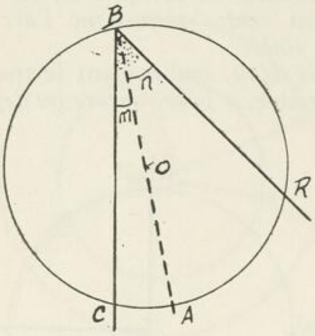


Fig. 100

De plus la somme a+n+x des angles du triangle vaut 180 degrés.

$$a+n+x=180 \text{ degrés}(1)$$

Comme les deux angles adjacents s et x sont supplémentaires on obtient

$$s+x=180 \text{ degrés } (2)$$

En examinant attentivement les égalités (1) et (2) on doit facilement constater que l'angle s vaut, à lui seul la somme des deux angles a et n et comme ces derniers angles sont égaux entre eux on conclut que l'angle a vaut la moitié de l'angle s,

$$a=\frac{s}{2}$$

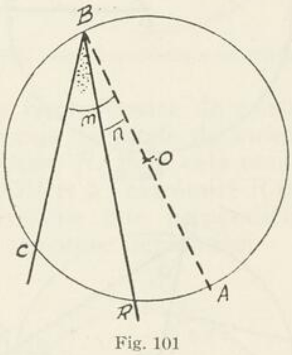


Fig. 101

L'angle s ayant pour mesure l'arc CR, l'angle a aura pour mesure la moitié de BC. Donc, l'angle inscrit a pour mesure la moitié de l'arc compris entre ses côtés.

Vous admettrez certainement cette démonstration mais vous vous direz peut-être que le cas n'est pas général et vous vous demanderez alors: qu'*adviendrait-il si l'un des côtés de l'angle inscrit ne passait pas par le centre*? Eh bien, voyons.

C'est bien facile et n'importe qui peut en dire autant; si l'un des côtés ne passe pas par le centre, il passe certainement à côté du centre et l'on peut envisager *deux cas*.

Les Figures 100 et 101 vont nous permettre d'examiner rapidement ces cas. *1er cas:* Dans la première de ces deux figures *le centre de la circonférence est à l'intérieur de l'angle donné.* Cet angle vaut donc l'angle m plus l'angle n qu'on obtient en menant le diamètre BA. L'angle m vaut la moitié de l'arc CA, l'angle n vaut la moitié de l'arc AR. Donc tout l'angle donné CBR vaut la moitié de l'arc CA plus la moitié de l'arc AR, c'est-à-dire la moitié de l'arc CR et l'angle inscrit CBC vaut la moitié de l'arc compris entre ses côtés.

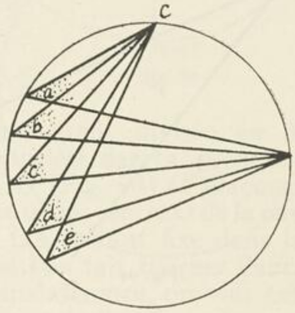


Fig. 102

2e cas: Dans la Figure 101 le centre de la circonférence est en dehors de l'angle. On remarque que l'angle donné vaut l'angle m moins l'angle n. Cet angle donné BCR mesure donc la moitié de l'arc CA moins la moitié de l'arc RA, c'est-à-dire la moitié de l'arc compris entre ses côtés.

La conséquence de ce théorème est que *si nous inscrivons des angles dans le même segment, tous ces angles seront égaux.* En effet les angles a, b, c, d, e (Fig. 102) mesurent tous la moitié de l'arc CD et ont par conséquent, la même valeur.

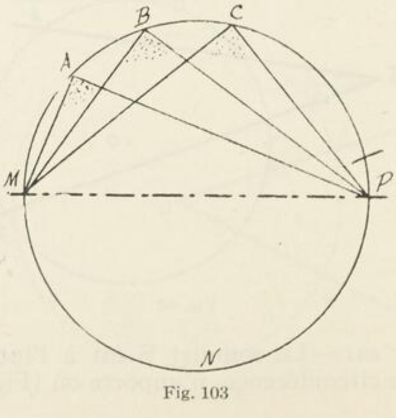


Fig. 103

Voici une deuxième conséquence précieuse de ce théorème: *tous les angles inscrits dans une demi-circonférence sont droits.* Pourquoi? Parcequ'ils ont tous pour mesure la moitié de l'arc MNP intercepté (Fig. 103). Or MNP = 180° ou 2 droits, dont la moitié donne 90° ou 1 droit.

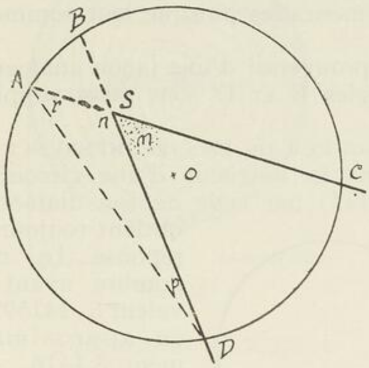


Fig. 104

III. Valeur de l'angle dont le sommet S est a l'intérieur de la circonférence. Théorème: *L'angle qui a son sommet à l'intérieur de la circonférence a pour mesure la demi-somme des arcs compris entre ses côtés et entre leurs prolongements.*

Soit l'angle DSC ou m (Fig. 104). Prolongeons les côtés DS et CS et menons la droite AD.

Nous savons que

$$n + m = 180 \text{ degrés.}$$

et nous savons aussi que

$$r + p + n = 180 \text{ degrés}$$

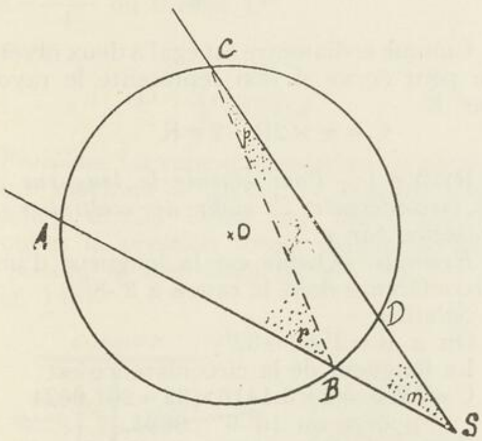


Fig. 105

donc l'angle m à lui seul, vaut la somme des angles r et p qui sont deux angles inscrits. L'angle r a pour mesure ½DC et l'angle p a pour mesure ½AB; ainsi l'angle m a pour mesure ½DC + ½AB... Donc.....

IV. Valeur de l'angle dont le sommet S est a l'extérieur de la circonférence. Théorème: *L'angle formé par deux sécantes qui se rencontrent en dehors du cercle a pour mesure la demi-différence des arcs compris entre ses côtés.*

Soit l'angle CSA ou m (Fig. 105). Menons la corde BC. L'angle r est extérieur au triangle BCS et il vaut la somme des angles m et p.

$$r = m + p$$

de cette égalité on tire

$$m = r - p$$

Or l'angle r a pour mesure ½ AC tandis que l'angle p mesure ½ BD. Donc l'angle m mesure la moitié de l'arc AC moins la moitié de l'arc BD.

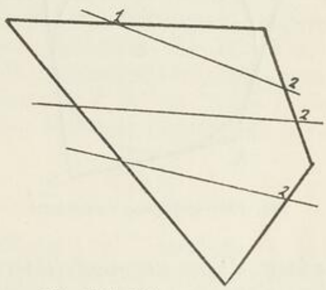


Fig. 106—Polygone convexe

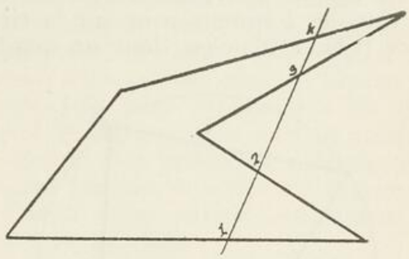


Fig. 107—Polygone concave

La mesure des angles est très importante en géométrie et nous allons voir un théorème qui va bien montrer l'importance de ce qui vient d'être expliqué.

Sachons d'abord qu'un *polygone convexe* (Fig. 106) est celui dont le périmètre (le tour) ne peut être rencontré en plus de deux points par une droite.

Un polygone qui n'est pas convexe est dit *concave* (Fig. 107).

Un polygone est *inscrit* dans une circonférence lorsque tous les sommets du polygone sont sur la circonférence (Fig. 108).

Un polygone est *circonscrit* à une circonférence lorsque tous les côtés du polygone sont tangents à la circonférence (Fig. 109).

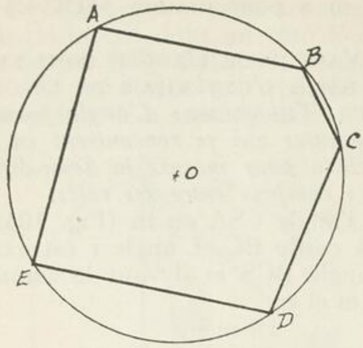


Fig. 108—Polygone inscrit

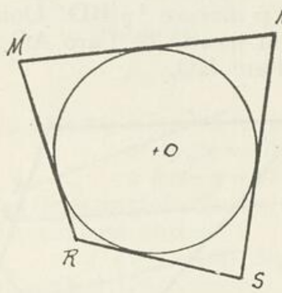


Fig. 109—Polygone circonscrit

THÉORÈME: *Dans un quadrilatère inscrit, les angles opposés sont supplémentaires.* Soit ABCD un polygone de quatre côtés dont tous les sommets sont sur la circonférence (Fig. 110); c'est donc un quadrilatère inscrit.

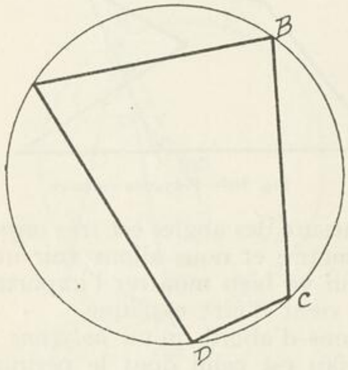


Fig. 110—Quadrilatère inscrit

Cherchons à prouver que l'angle A plus l'angle C égalent 180 degrés,

$$A+C=180$$

et que $B+D=180$

L'angle A est un angle inscrit; il mesure donc la moitié de l'arc BCD. L'angle C est aussi un angle inscrit et il mesure la moitié de l'arc BAD.

Nous avons donc

$$A=\tfrac{1}{2}BCD$$
$$C=\tfrac{1}{2}BAD$$

en additionnant on trouve

$$A+C=\tfrac{1}{2}BCD+\tfrac{1}{2}BAD$$

c'est-à-dire la moitié de toute la circonférence (360 degrés) ce qui nous donne 180 degrés. Donc les angles A et C sont supplémentaires puisque leur somme vaut 180°.

On prouverait d'une façon analogue que les angles B et D sont aussi supplémentaires.

LONGUEUR DE LA CIRCONFÉRENCE.— En divisant la longueur d'une circonférence (Fig. 111) par celle de son diamètre, on obtient toujours pour réponse le même nombre ayant pour valeur 3. 141592324... ou approximativement 3.1416.

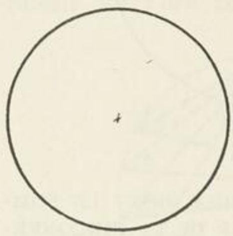


Fig. 111—Circonférence

On exprime ceci en disant que le rapport de la circonférence au diamètre est un nombre constant. Ce nombre constant, 3,1416, se désigne par la lettre grecque π, qu'on prononce pi.

Si l'on représente la longueur de la circonférence par C et le diamètre par D, on aura:

$$\frac{C}{D}=3.1416, \text{ ou } \frac{C}{D}=\pi$$

d'où

$$C=\pi d \text{ et } D=\frac{C}{\pi}$$

Comme le diamètre est égal à deux rayons on peut écrire si l'on représente le rayon par R

$$C=\pi\times 2R=2\pi R$$

RÈGLE 1:—*Pour obtenir la longueur de la circonférence il suffit de multiplier le diamètre par* π.

Exemple:—Quelle est la longueur d'une circonférence dont le rayon a 2′-8″?

Solution:—

On a R=2′-8″=32″

La longueur de la circonférence est:

$C=2R\pi=2\times3.1416\times32=201.0624$ pouces ou 16′-9″ .0624.

RÈGLE 2. *Pour obtenir le diamètre d'une circonférence dont on connait la longueur il suffit de diviser cette longueur par 3.1416.*

Exemple:

Quelle est l'épaisseur d'un arbre de 25 pieds de tour? (Fig. 112).

Solution:

L'épaisseur de l'arbre est évidemment la longueur du diamètre. On obtient donc

$$D = \frac{C}{\pi} = \frac{25}{3.1416} = 7.96 \text{ ou } 7'\text{-}11.5''$$

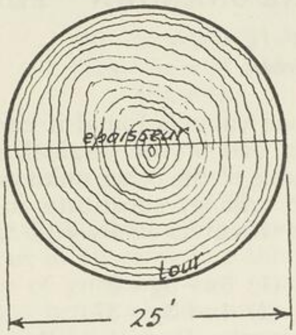


Fig. 112

SURFACE DU CERCLE.

REGLE.— *Pour obtenir la surface d'un cercle il suffit de multiplier le nombre 3.1416 par le carré du rayon.*

$$S = \pi R^2$$

Pour obtenir la surface d'un cercle on peut encore multiplier le carré du diamètre par 0.7854.

De la formule

$$S = \pi R^2$$

on tire $R^2 = \frac{S}{\pi}$

et $R = \sqrt{\frac{S}{\pi}}$

on pourrait de même de la formule

$$S = \frac{\pi D^2}{4} \text{ ou } 0.7854\ D^2$$

trouver

$$D = \sqrt{\frac{S}{0.7854}}$$

Problème: La vapeur agissant sur le piston d'une machine à vapeur, y produit une pression de 25 livres par pouce carré. Trouver la pression totale supportée par le piston, si son diamètre est de 1'-4". (Fig. 113).

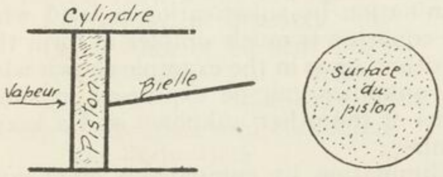


Fig. 113

Solution:

Le diamètre D = 1'-4" = 16 po.

La surface du piston se calcule d'après la formule

$$S = 0.7854 D^2$$

qui donne

$$S = 0.7854 \times 16^2 = 0.7854 \times 256 = 201.0624 \text{ po. car.}$$

La surface du piston est donc de 201 po. car. environ et comme il y a une pression de 25 livres à chaque pouce carré, la pression totale P est:

$$P = 201.0624 \times 25 = 5026.56 \text{ livres.}$$

à suivre

Le Calcul Graphique à l'Usine

(*Suite de la page 10*)

partir d'un point "O" les segments "O S" et "O P" se recouvrant l'un l'autre et représentatifs des quantités "e" et "f", puis en direction différente traçons aussi le segment unitaire "O R". On pourra alors compléter les deux triangles semblables quelconques "O P R" et "O S T" tels que représentés, lesquels donneront la relation

$$\frac{x}{1} = \frac{a}{f}.$$

La distance "x", évaluée à la même échelle, correspondra au quotient désiré.

Jusqu'ici nous avons traité la solution graphique des quatre opérations fondamentales simples—addition, soustraction, multiplication, division—et l'objectif visé ne saurait être atteint sans un exposé des cas beaucoup plus intéressants de puissances et de racines, avec tout au moins un léger aperçu des premières notions trigométriques parfois si utiles à l'ouvrier: ce sera l'objet d'un article subséquent dû pour le mois prochain.

Il serait d'ailleurs injuste d'abuser davantage de la généreuse hospitalité que l'on nous fait, et c'est avec empressement que nous nous retirons pour faire place à d'autres plumes beaucoup plus autorisées que la nôtre, qui n'attendent que l'occasion de dispenser les bienfaits de leur ministère éducationnel au bénéfice de la cause de l'usine.

(à suivre)

CRUEL SOUVENIR

—Conducteur, pourquoi la locomotive lance-t-elle toujours un cri de désolation quand elle passe ici?

—C'est une place de pique-nique, et c'est là que le mécanicien a vu sa femme, pour la première fois, vous savez.....

Elementary Algebra for Beginners with Some Practical Applications

(EQUATIONS CONTAINING MORE THAN ONE UNKNOWN — Part IV)

By George Stevenson
Professor, Montreal Technical School

In dealing with simple equations containing one unknown we found that the value of the unknown could be definitely determined. If, however, we have an equation containing two unknowns, we cannot find a definite value for either of them and can only express one in terms of the other. For example, the difference of two numbers is 5, find the numbers. Let x be the larger number and y the smaller then $y-y=5$ if we try to solve the equation we can get numerous values for both x and y. Thus if $x=10$ $y=5$, if $x=8$ $y=3$, if $x=6$ $y=1$, if $x=5$ $y=0$. Such an equation is called an indeterminate equation. If we are told that the sum of the two numbers is 11 we can in the same way find from the equation $x+y=11$, that if $x=2$ $y=9$, if $x=4$ $y=7$, if $x=5$ $y=6$, if $x=8$ $y=3$, if $x=10$ $y=1$. It may be noticed that the pair of values $x=8$ and $y=3$ occur in both sets of values, *i.e.*, that these values satisfy both equations. A pair of equations satisfied in this way are called simultaneous equations. The only equations which can be reasonably solved simultaneously are those which are independent of one another. It is not convenient to solve equations by finding values which will satisfy each equation and then picking out the corresponding values of each. The different methods used all lead to one equation with one unknown, therefore one unknown must first be eliminated. There are three ways of eliminating one unknown.

1. Elimination by subtracting or adding.
2. Elimination by substitution.
3. Elimination by comparison.

Of the three methods, that by adding or subtracting is the most generally used. The simplest pair of simultaneous equations to solve are the type already given viz, the sum and difference of two numbers being given.

(1) $x+y=17$
(2) $x-y=7$

adding the two equations $2x=24 \therefore x=12$
subtracting (2) from (1) $2y=10 \therefore y=5$
only one of these operations is necessary as when one value is found it can be substituted in one of the original equations and the value of the other unknown found, thus after adding, substitute in (1) the value for x this gives $12+y=17 \therefore y=17-12=5$.

Ex.: 2 (1) $3x-5y=6$
(2) $4x+3y=37$

Here we can eliminate either x or y. To eliminate one of the unknowns we must have the same co-efficient for that unknown in each equation. The smallest possible co-efficient is the L. C. M. of the given co-efficients. Suppose we eliminate x. We must multiply (1) by 4 and (2) by 3 to get 12 the L. C. M. of the two co-efficients of

(2) multiplied by 3 gives $12x+9y=111$ (3)
(1) multiplied by 4 gives $12x-20y=24$ (4)

subtracting $29y=87$
$y=3$
substituting in (1) $3x-15=6$
$\therefore 3x=6+15$
$3y=21$
$y=7$

Elimination by substitution given

$y=10-2x$
$7x+8y=53$

substituting the value of y from the first equation in the second gives

$7x+8(10-2x)=53$
$7x+80-16x=53$
$7y-16x=53-80$
$-9x=-27$
$x=3$. Now substituting in the first equation

$y=10-2x$
$y=10-6$
$y=4$

Elimination by substitution is used where one equation is much simpler in form than the other, or as in the example shown where one unknown can be expressed in simple terms of the other unknown and a known number.

Elimination by comparison, given equations

$5x+7y=50$ (1)
$3x+y=14$ (2)

solving (1) for y gives $y=\frac{50-5x}{7}$

(2) for y gives $y=14-3x$

these two values of y must be equal.

$$\therefore\ \frac{50-5y}{7}=14-3x$$

$$50-5x=98-21x$$

$$21x-5x=98-50$$

$$16x=48$$

$$x=3$$

substituting in (2) $9+y=14$

$$y=14-9$$

$$y=5$$

Any one of the three methods shown may be used but in all cases free the equations from signs of grouping, and usually, clear of fractions before eliminating.

Problems leading to simultaneous equations.

Ex. 1: Find a fraction such that if 1 be added to its numerator it reduces to 1/5, if 1 be added to its denominator it reduces to $\frac{1}{7}$ suppose the fraction is $\frac{y}{x}$

adding 1 to the numerator gives $\frac{x+1}{y}=\frac{1}{5}$ (1)

adding 1 to the denominator gives $\frac{x}{y+1}=\frac{1}{7}$ (2)

multiply (1) by 5y to clear of fractions

$5x+5=y$ or $5x-y=-5$ (3)

Multiply (2) by 7 (y+1) then $7x=y+1$

or $7x-y=1$ (4)

subtracting (3) from 4

$$7x-y=1$$

$$5x-y=-5$$

$$2x\quad=6$$

$$x\quad=3$$

Substituting in (1)

$$\frac{3+1}{y}=\frac{1}{5}\text{ i.e. }\frac{4}{y}=\frac{1}{5}$$

$$\therefore\ y^2=20$$

the given fraction was $\therefore\ \frac{3}{20}$

Ex. 2: The sum of \$9.25 is made up of 28 coins which are either quarters or 50 cent pieces. How many are there of each?

Let x = no. of quarters

Let y = no. of 50 cent pieces

No. of coins value

$x+y=28$ $.25x+50y=9.25$

clearing of decimals and combining

$$25x+50y=925$$

$$25x+25y=700$$

$$25y=225$$

$$y=9\ \therefore\ x=19$$

Ex. 3: Given two alloys, one containing 45% zinc, the other containing 20% zinc, how many lbs of each must be taken to make an alloy of 400 lbs containing 35% zinc.

Let x = no. of lbs taken of the 45% zinc.

Let y = no. of lbs taken of the 20% zinc.

We consider the number of lbs of mixture and the number of lbs of zinc.

Lbs of mixture Lbs of zinc

$x+y=400$ (1) $\frac{45}{100}x+\frac{20}{100}y=\frac{35}{100}\times 400$ (2)

$$45x+20y=14000$$

Multiply (1) by 20

$$20x+20y=8000$$

$$25x\quad=6000$$

$$x\quad=240\text{ lbs}$$

$$\therefore\ y\quad=160\text{ lbs.}$$

Ex. 4: Out of 64 castings weighing altogether 4840 lbs some weigh 60 lbs each and the remainder weigh 85 lbs each, how many of each kind are there?

Let x = No. of 60 lb castings.

Let y = No. of 85 lb castings.

Total weight $=60x+85y=4840$ (1)

No. of castings $=x+y=64$ (2)

multiplying (2) by 60 and subtracting from (1) gives

$$60x+85y=4840$$

$$60x+60y=3840$$

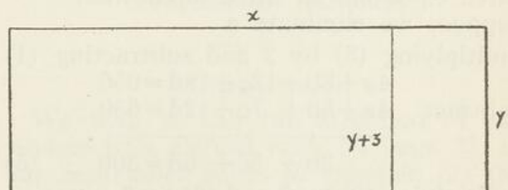
$$25y=1000$$

$$y=40$$

and from (2) $x=24$

that is there are 24 weighing 60 lbs each and 40 weighing 85 lbs each.

Ex. 5: A drill jig is to have 3 holes 7/8″ diameter two of which are 7 9/16″ apart and the third 5 1/16″ from one and 6 3/8″ from the other. The holes are to be bored out the largest possible size and hardened steel bushings put in so that each bushing touches the other two, what sizes must the holes for the bushings be bored out?



In the sketch A, B and C are the centers of the holes required if each of the bushings touch the other two the large circles represent the sizes of the bushings. Suppose the radii of the circles A, B and C are x, y, z, respectively, then, $x+y=6\frac{3}{8}$ (1)

$x+z=7\frac{9}{16}''$ (2)

$y+z=5\frac{1}{16}''$ (3)

combining (1) and 3 to eliminate y gives

$$x+y=6\frac{3}{8}$$
$$y+z=5\frac{1}{16}$$
$$x-z=1\frac{5}{16} \qquad (4)$$

add $(4\frac{3}{4}$ to (2)

$$x-z=1\frac{15}{16}$$
$$x+z=7\frac{9}{16}$$
$$2x=8\frac{7}{8}$$
$$x=4\frac{7}{16}$$

from (1) $y=6\frac{3}{8}-4\frac{7}{16}=1\frac{15}{16}$

from (2) $z=7\frac{9}{16}-4\frac{7}{16}=3\frac{1}{8}$

the bushings must be laid out with radius of A $4\frac{7}{16}''$

radius of B $1\frac{15}{16}''$ radius of C $3\frac{1}{8}''$

as the diameter equals twice the radius, the holes will have to be bored double these sizes or $8\frac{7}{8}''$, $3\frac{7}{8}''$, $6\frac{1}{4}''$ diameter

Ex. 6: The employees in a manufacturing plant receive four scales of pay per week. The paymaster in making up the envelopes in paying out 4 at 1st rate, 5 at 2nd, 7 at the 3rd, and 12 at the 4th, pays out $650.

In paying 3 at 1st, 8 at 2nd, 10 at 3rd, 15 at 4th, he pays out $825.

In paying 2 at 1st, 4 at 2nd, 6 at 3rd, 9 at 4th, he pays our 478.

In paying 5 at 1st, 7 at 2nd, 8 at 3rd, 16 at 4th, he pays out $833.

Find each rate of pay.

Suppose the rates of pay are a, b, c and d dollars per week

$$4a+5b+7c+12d=650 \qquad (1)$$
$$3a+8b+10c+15d=825 \qquad (2)$$
$$2a+4b+6c+9d=478 \qquad (3)$$
$$5a+7b+8c+16d=833 \qquad (4)$$

First eliminate one unknown to leave three equations in three unknowns: suppose we eliminate a

multiplying (3) by 2 and subtracting (1)

$$4a+8b+12c+18d=956$$

subtract $4a+5b+7c+12d=650$

$$3b+5c+6d=306 \qquad (5)$$

multiplying (2) by 2 and (3) by 3

$$6a+16b+20c+30d=1650$$

subtract $6a+12b+18c+27d=1434$

$$4b+2c+3d=216 \qquad (6)$$

multiplying (3) by 5 and (4) by 2

$$10a+20b+30c+45d=2390$$

subtract $10a+14b+16c+32d=1666$

$$6b+14c+13d=724 \qquad (7)$$

next eliminate one unknown to leave two equations in two unknowns; suppose we eliminate b

multiply (5) by 4

$$12b+20c+24d=1224$$

multiply (6) by 3

$$12b+6c+9d=648$$
$$14c+15d=576 \qquad (8)$$

from (7) $6b+14c+13d=724$

subtract (5) multiplied by 2

$$6b+10c+12d=612$$
$$4c+d=112 \qquad (9)$$

multiply (8) by 2 $28c+30d=1152$

multiply (9) by 7 $28c+7d=784$

$$23d=368$$
$$d=16$$

from (9) $4c=112-16=96$

$\therefore c=24$

from (6) $4b=216-48-48=120$

$\therefore b=30$

from (1) $4a=650-150-168-192=140$

$\therefore a=35$

the rates of pay per week are $35, $30, $24, $16.

Quadratic equations or second degree equations

If an equation contains the second power of the unknown quantity but no higher power it is called a quadratic equation or equation of the second degree. If only the second power of the unknown occurs in the equation it is called a pure quadratic, if both second and first powers of the unknown, it is called an adfected quadratic. As the pure quadratics are so easily solved, we bother ourselves only with the solution of adfected quadratics. A pure quadratic is solved as easily as a simple equation, for instance,

$$\frac{x^2-25}{24}=\frac{x^2-9}{40}$$

multiply by 120 gives

$$5x^2-125=3x^2-27$$
$$2x^2=98$$
$$x^2=49$$
$$x=\pm 7$$

the double sign plus or minus is used because, from the rule of signs in multiplication, a positive quantity may result from the product of two positive quantities, or the product of two negative quantities.

The equation $x^2=49$ is a type of the simplest of quadratic equations. The equation $(x-4)^2=36$ may be solved in a similar way; taking the square root of each side gives

$$x-4=\pm 6 \;\therefore\; x=\pm 6+4=10 \text{ or } -2$$

the equation $(x-4)^2=36$ could be written $x^2-8x+16=36$ or $x^2-8x+(4)^2=36$ or $x^2-8x=20$ or $x^2-8x-20=0$ which is a common form of the quadratics most frequently met with. Working backwards we find that the equation $x^2-8x-20=0$ can be solved by transposing the known term to the right, and adding 4^2 to both sides and then extracting the square root, the reason for adding 4^2 to the left side being to make it a perfect square.

Now $(x+a)^2=x^2+2ax+a^2$

and $(x-a)^2=x^2-2ax+a^2$

For all values of a, we see then that if a trimonial is a perfect square and its highest power x^2 has unity for co-efficient, the term without x is always equal to the square of half the co-efficient of x. Therefore if the terms in x^2 and x are given it is always possible to make a perfect square by adding the square of half the co-efficient of x Ex. 1: $x^2+24x=25$

the square of half 24 is 12^2

$$\therefore x^2+24x+12^2=12^2+25=169$$

extracting the square root

$$x+12=\pm 13$$

$$x=\pm 13-12$$

$$=1 \text{ or } -25$$

Ex. 2: $x^2-25x-24=0$

$$x^2-25x=24$$

the square of half -5 is $\left(\frac{5}{2}\right)^2$

$$\therefore x^2-5x+\left(\frac{5}{2}\right)^2=24+\frac{25}{4}=\frac{121}{4}$$

$$\therefore x-\frac{5}{2}=\pm\frac{11}{2}$$

$$\therefore x=\pm\frac{11}{2}+\frac{5}{2}$$

$$\therefore x=8 \text{ or } -3$$

Ex. 3: $5x^2-33x+18=0$

$$x^2-\frac{33}{5}x=-\frac{18}{5}$$

$$x^2-\frac{33}{5}x+\left(\frac{33}{10}\right)^2=-\frac{18}{5}+\frac{1089}{100}$$

$$x-\frac{33}{10}=\sqrt{\frac{-360+1089}{100}}$$

$$=\sqrt{\frac{729}{100}}=\pm\frac{27}{10}$$

$$\therefore x=\pm\frac{27}{10}+\frac{33}{10}$$

$$=6 \text{ or } \frac{3}{5}$$

From the above it may be seen that any quadratic may, after transposing and rearranging the terms be expressed in the form $ax^2+bx+c=0$ where a, b, and c may have any numerical values we like to give to them. If this quadratic can be solved we can then solve any quadratic.

Transposing $ax^2+bx=-c$

dividing by a $x^2+\frac{b}{a}x=-\frac{c}{a}$

adding the square of half the co-efficient of x to both sides gives

$$x^2+\frac{b}{a}x+\left(\frac{b}{2a}\right)^2=\left(\frac{b}{2a}\right)^2-\frac{c}{a}$$

$$=\frac{b^2}{4a^2}-\frac{c}{a}=\frac{b^2}{4a^2}-\frac{4ac}{4a^2}$$

$$=\frac{b^2-4ac}{4a^2}$$

taking the square root

$$x+\frac{b}{2a}=\frac{\pm\sqrt{b^2-4ac}}{2a}$$

$$\therefore x=\frac{-b}{2a}\;\frac{\pm\sqrt{b^2-4ac}}{2a}$$

$$=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

The two values of x are $\frac{-b+\sqrt{b^2-4ac}}{2a}$

and $\frac{-b-\sqrt{b^2-4ac}}{2a}$

This can be used as a formula for the solution of all quadratics. If b^2-4ac is a perfect square we have the most usual and most convenient quadratic; if however b^2-4ac is not a perfect square, its value can be got only approximately, depending on the number of decimal places to which we extract the square root. If b^2-4ac is a negative quantity the solution is impossible, because there is no quantity positive or negative whose square is negative.

(*To be continued next month*)

Correction

We wish to call the attention of our readers to a clerical error on page 25, in our September issue. In example (2) the problem shou.d have read:—

"A man bought three articles. The second cost three times as much as the first and the third six dollars more than the second, etc."

Evidently the word "times" was substituted for the proper word "dollars."

Graduates' Page

ENGLISH GRADUATE SOCIETY
Montreal Technical School

OFFICERS, 1928-29

Hon. President . . . . IAN McLEISH

President
J. R. McGRATH, '22

1st Vice President: K. BURKETT, '22

2nd Vice President: C. BALL, '24

Secretary: V. SCHENKER, '26, 74 Laurier Ave. West, BElair 6574-W

Treasurer: JOHN ALT, '24, 5995 St. Denis St., CAlumet 1999

Membership

There are still quite a number of graduates who have not forwarded their annual dues ($2.00) to the Society for the season 1928-1929. As the activities of the Society depend almost entirely on the funds available for its use, every graduate should cooperate and send in his dues as early as possible. It should not be necessary for an officer of the Society to approach each man every year. Fees may be sent to Mr. John Alt, 5995 St. Denis, or Mr. Ian McLeish, at the Montreal Technical School, 200 Sherbrooke St. West.

Hockey

As the hockey season draws near the Montreal Technical School is by no means in the rear ranks.

On Wednesday evening the 14th of November, a meeting was held in the school for the purpose of organizing a hockey league.

The following officers were elected:

Honorary Presidents:	Mr. A. Bélanger, (Principal)
	Mr. I. McLeisch, (Asst.-Principal)
General Director:	Mr. J.C.A. Demers (Professor)
President:	Mr. C. M. Kinghorn, Third Year
Vice-President:	Mr. Robert, Third Year
Secretary:	Mr. Beauchamp, Third Year
Treasurer:	Mr. Holden, Third Year

The team managers elected were: Messrs. Lunn, Grosser, Robert and Beauchamp.

It is the aim of the Committee to form four teams between the English and French sections and to pick an all-star team from these four to play outside colleges.

The league is already well under way and a very promising season is in view. The Coliseum has been rented for two hours a week. Thursday evening from 5 until 6 o'clock and on Saturday from 1 to 2 o'clock. The pupils are requested to attend these games and practices and to encourage the players as much as possible.

The class as a whole wishes to extend its thanks to Mr. Bélanger and to the professors who assisted in the organizing of the league.

The donation given by the school through Mr. Bélanger enables the league to obtain one of the best indoor rinks in the city.

Rugby

On November 12th, a rugby match was held on Fletchers Field between first and third years (English).

The first year team was under the management of Mr. Demers who had arranged for the game some time before.

Although neither team had had much practice previous to the game a very good showing was made by both sides. Good sportsmanship was shown by both teams. The final score was 2-1 in favor of third year.

Another game was scheduled for Nov. 17th, but the weather prevented the teams from playing.

It is hoped that this game is the forerunner of many more to be held in the future. It was largely through Mr. Demers' efforts that these rugby teams were organized.

"*Technique*"

The graduates of the Montreal Technical School are fortunate in having at their disposal a very interesting magazine in which they may present their views to the public from time to time and insert various articles. Every graduate of the School should feel it a duty to be a subscriber and send in at least two other subscriptions from among his friends. The subscription, which is one dollar ($1.00) per year, should be sent immediately to the Treasurer of the subscription committee Mr. A. Bellizzi, 3854 Verdun Ave., Verdun.

Prizes Offered by the Provincial Government for Articles Appearing in "Technique"

Mr. Augustin Frigon, Director of Technical Education for the Province of Quebec, who was the honored guest at the annual dinner of the English Graduate Society last season, has offered two prizes of Twenty-Five and Twenty Dollars respectively, for the two best articles sent in by members of the English Graduate Society during the season 1928-1929.

It must be remembered that the articles must reach Mr. McLeish early in the season to insure publication, as they must appear in TECHNIQUE in order to be considered. Therefore any of the graduates contemplating entering this contest should send in their articles at an early date.

Executive Meetings

An executive meeting was held recently at the Oxford Grill for the purpose of discussing the activities of the Society. The Smoker was the main item under discussion and a financial report showed that the Society funds were increased some what. Various other items which were also under discussion are outlined in full elsewhere on this page.

The meeting of the executive with the TECHNIQUE committee was held at the School on Friday November 17th, at 8 p.m. to discuss ways and means of boosting the subscriptions to TECHNIQUE, also the obtaining of additional advertising and articles for the same. Mr. McLeish then pointed out that articles from graduates were particularly desirable. He suggested also that each graduate bring in at least ten subscriptions before the New Year.

Past Lecture

The lecture given on Friday, November 9th 1928, by the Rev. J. M. Baillargeon, Professor of Mathematics of Montreal College, was thoroughly enjoyed by all present. The lecture was given through the courtesy of the "Agfa Products Limited" and was attended by 50 of the members and friends, a very good turn-out considering the short notice. A large number of coloured slides were shown and provided a very interesting and instructive addition to the lecture.

We might mention that the slides shown by Father Baillargeon were out of the ordinary, some of the floral displays being most gorgeous, and nearly all were taken in and around Montreal. One never realizes what beauties surround him until he receives an awakening, such as produced by the exhibition of these slides.

In Memoriam

It is with regret that we announce the passing of one of our graduates, Charles Thériault, of Class 1922.

Mr. Thériault was an active member of the English Graduates' Society of the Montreal Technical School, having followed the course in English while at the School. Just previous to his demise, he was employed by the Vilas Company of Cowansville, Que., on their oil burning equipment and, from all reports, was giving every satisfaction and was well liked by his employers.

On July 23rd last, he was transferred to their Montreal office and soon after began to complain of pains in the region of his heart and lungs. After lingering for four months he passed away December 3rd, and was buried in Cote des Neiges Cemetery on December 5th. The above picture of him was taken on August 23rd, 1928.

While at School and indeed all through his life, Charles Thériault, was a young man of exemplary character. He made friends wherever he went, for he was kind, unassuming and courteous to everyone. His fellow graduates will miss him greatly in their meetings and our most heartfelt sympathy goes out to his parents and relatives for their great loss.

Third Lecture

Dr. H. T. Barnes addressed the third meeting of the Society on Monday, December 3rd, 1928 on the subject of "Ice Fighting." The Chairman Mr. K. Burkett introduced the speaker to the audience of about 50 graduates and friends.

Dr. Barnes stated that ice was not frozen water but a distinct substance in itself composed of $3H_2O$ molecules, and that in removing ice jams it was not necessary to melt the ice into water which process required 80 calories of heat per gram but simply to bring the ice to a liquid state known as liquid ice which requires but 18 calories of heat per gram. Ice molecules are always present in water right up to the boiling point of the latter. Ice jams are not caused by ice frozen on the surface of the water but by frazzil ice which is formed in swift running water and carried under the surface ice where it accumulates to a depth of 10 or 15 feet. In his treatment of ice with thermit a cylinder containing aluminium in the bottom and iron at the top, with a detonator for setting it off, is placed in a hole dug in the ice and is then discharged electrically. In the resulting action the iron and aluminium combine chemically and the mass is heated to 5000°F within a period of 8 seconds. This terrific heat melts the bottom of the cylinder and the molten iron comes in contact with the ice and immediately a chemical reaction takes place liberating hydrogen gas in molecules of 3H which is highly explosive and it is this explosion which gives the spectacular effect associated with thermit. The rays of light given off at the high temperature penetrate the ice mass and are mainly responsible for the disintegration of the mass within 24 hours.

Experiments on icebergs are to be continued in the near future and the keeping of the St. Lawrence waterway open the year round was referred to as a possible achievement.

Numerous slides were shown illustrating ice particles in the liquid state as seen under a microscope, slides of ice jams in various parts of the country and icebergs around Newfoundland were also shown. A group of slides illustrating the symmetrical shapes of snowflakes in which not two flakes alike were very interesting.

At the close of the lecture Mr. L. Cowan tendered the speaker a vote of thanks, which was warmly seconded by those present.

Dance

The Society's Mid-Season Dance held in Majestic Hall on Friday, Nov. 30th, 1928 was enjoyed by the graduates and their friends who attended in spite of unfavorable weather. The music as furnished by the "new electromagnetic pick-up process" was a complete success. The musical selections left nothing to be desired and the time and volume of the music were excellent. There were 14 dances with two encores to each dance and the intermission was from 11 to 11.45 p.m. during which refreshments were served.

In future, mid-season or monthly dances will have to be held, if possible, without the overhead expense caused by the renting of a hall and other incidental expenses. If the Society had a clubroom to accomodate 30 or 40 couples for dancing this expense would be unnecessary.

Christmas Trees

By Canadian Forestry Association, Ottawa, Can

About seven million trees will be used in North America this Christmas. The question immediately arises: Are we devastating our forests by brightening up the homes and making millions of youngsters happy at Christmas time?

Prominent authorities such as Dr. C. D. Howe, Dean, Faculty of Forestry, University of Toronto, in Canada and Wm. G. Howard, Superintendent of State Forests, New York State, in United States say "No."Dean Howe says "an area of thirty square miles if set aside and managed for Christmas tree production, would supply the present demand for each year for all time."

The average size of the Christmas tree marketed in the States is six feet. A spruce tree of this size can be grown in the nursery inside of ten years and in the forest in fifteen.

Mr. Howard says—"Trees are for use, and there is no other use to which they could be put that would contribute so much joy to mankind as their use by children on this great holiday." He further states "In our state, a large proportion of Christmas trees are cut from pasture lands, where they are a nuisance, or from other lands which the owner desires to clear for farm purposes, so that the trees would be cut in any event and the marketing of them for Christmas gives the owner some return for his labor."

In Europe, where Forestry practice has reached its highest development, Christmas trees are thinnings which are culled out of the forest, which practice actually improves the forest. Hence there is scarcely a hut dweller who has not his Christmas tree.

In Canada, the Canadian Forestry Association would advocate that in connection with forest plantations, there should be planted some spruce and balsam for Christmas trees. When, then, they reach the proper size the owner can cut them out and market them and still leave the timber tree to mature for a timber crop. This source of supply would probably be sufficient to supply the home demand. For export trade plantations of spruce and balsam should prove a profitable business. Two thousand Christmas trees could be grown on one acre. Thus, on a ten year rotation, ten square miles would supply $1\frac{1}{4}$ million trees for all time, at a planting cost of less than one cent per tree. Here is an opportunity for enterprising community, townships, or individuals to utilize some abandoned farms to good purpose. This year in New Brunswick alone there is a demand for three million Christmas trees.

PROVINCE DE QUÉBEC

Secrétariat de la Province

Ecole des Beaux Arts

de Québec

37, RUE ST-JOACHIM, 37

Directeur, Jan Bailleul

Et l'art, ornant depuis sa simple architecture,
Par ses travaux hardis surpasse la nature.
BOILEAU

ÉTUDE ET COMPOSITION DÉCORATIVE D'UN ÉLÈVE
DU COURS DE SCULPTURE

Enseignement gratuit

L'Ecole est ouverte aux jeunes gens et aux jeunes filles.
L'enseignement comprend:
Architecture, Sculpture, Peinture, Gravure (eau forte), Art décoratif.

1° **Architecture:** Formation d'architectes diplômés, (5 ans d'étude), pour les dessinateurs, menuisiers, ingénieurs et tous les entrepreneurs industriels, etc., architecture pratique (cours du soir).

2° **Dessin, Peinture, Aquarelle.**

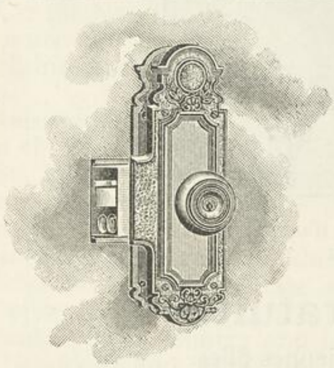
3° **Sculpture statuaire et ornementale.**

4° **Art décoratif** (théorique et pratique).
Nous donnons à l'Ecole des Beaux Arts de Québec, une grande importance au développement des Arts décoratifs avec adaption aux métiers.
Etude pour le papier peint, les soieries, la céramique, le verre, les vitraux, etc.

5° Cours oraux et spéciaux: Sciences appliquées à l'architecture. Descriptive, Perspective, Statique graphique, Mathématiques, etc. Anatomie artistique, histoire de l'art et de dessin à main levée.

LES COURS ONT LIEU DU 1er OCTOBRE A LA FIN DE MAI

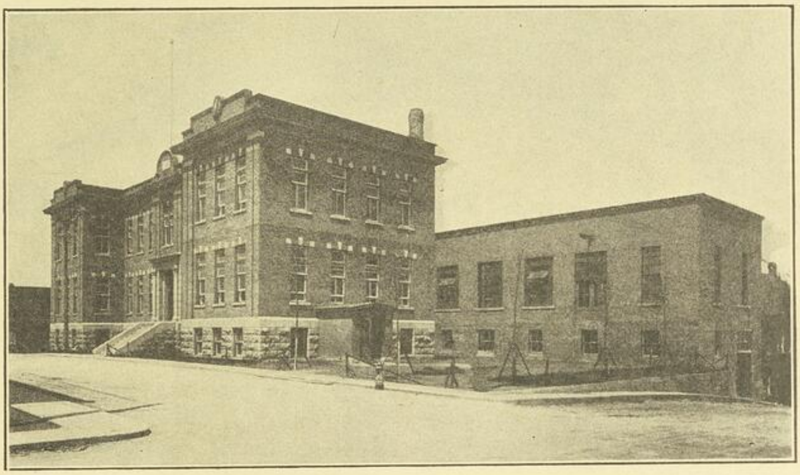
L'inscription des élèves, commence du 1er juin au 1er octobre



ÉCOLE TECHNIQUE DE HULL

Ouverte en octobre 1924

Destinée à une population canadienne-française de 85,000 âmes
répartie entre Ottawa et Hull



VUE D'ENSEMBLE

HULL compte, en 1926, 38,000 âmes (troisième ville de la province de Québec), possède plus de trente industries dont la principale est la manufacture de pulpe, papier et allumettes Eddy.

Avec les 1,700,000 C.-V. disponibles sur les rivières Ottawa et Gatineau, Hull est le plus grand centre de production d'énergie hydro électrique de l'Amérique du Nord.

L'Ecole Technique de Hull offre, en un cours bilingue de trois années, l'enseignement théorique et la formation manuelle dans les spécialités suivantes:

AJUSTAGE	MODELAGE	FONDERIE
MENUISERIE	FORGE	ELECTRICITE

RÉTRIBUTION MENSUELLE:

$1.50 en première année $2.00 en deuxième année $3.00 en troisième année

Un cours abrégé de douze semaines offre la formation théorique et pratique aux mécaniciens de garage.

COURS DU SOIR GRATUITS

Etablis en 1924

De 7 h. 30 à 9 h. 30 du soir

(1er OCTOBRE-AVRIL)

Ajustage, 40 leçons de 2 heures	Electricité, 40 leçons théoriques de 2 heures
Menuiserie et Modelage, 40 leçons de 2 heures	Electricité, 20 leçons pratiques de 2 heures
Dessin, 40 leçons de 2 heures	Automobile, 25 leçons théoriques et pratiques

Automobile, 40 leçons pratiques

COURS NOUVEAUX OFFERTS EN OCTOBRE 1926

Chimie industrielle (Pulpe et Papier)........40 leçons
Plomberie et Ferblanterie........40 leçons
Electricité de l'Automobile........20 leçons