Number of gallons leakage
$= (291.1894 \times 240) \div 277.118 = 252.118$ nearly
$= 252$ gallons and almost $1\frac{1}{2}$ pints.

A square enclosure has a side 40 feet in length. In front of it, and at a distance of 40 feet from each of the two nearest corners, a cow is tethered by a rope 100 feet long. Find the area of the ground over which the animal can graze.
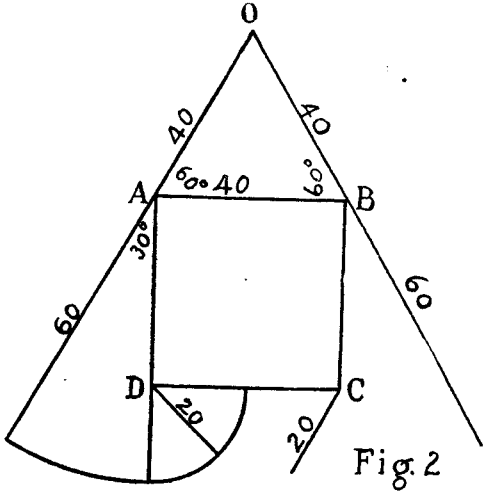

Fig. 2

Solution.—Let O be the stake and AB the side of the square. Then OAB is an equilateral triangle; area $= .433 \times 40^2 = 69.28$. When the rope is in a straight line with OA it may swing round in a circle till it is in line with OB. This is $\frac{5}{8}$ of circle of radius 100; area $= \frac{5}{8} \times \frac{22}{7} \times 10000$. When the cow passes nearer to the square than OA and OB, the points A and B become the centres, with radius 60 feet. The angle beyond the corner of the square is 30°, hence these two sectors are equal to $\frac{1}{12}$ of a circle of radius 60; area $= \frac{1}{12} \times \frac{22}{7} \times 3600$. Round the corners C and D on the further side of the square the rope can turn through 90° on each side. These parts are equal to half a circle with radius 20; area $= \frac{1}{2} \times \frac{22}{7} \times 400$. The circular parts added give 28704.7616, to which add the equilateral triangle OAB, and we get the whole area $= 28774.0416$ square feet.

No. 47. (No. 81, June, 1895.) The *Globe* newspaper of Monday, June 8th, 1877, bears number 8,505. Supposing the paper to have been published every week-day without intermission, and numbered consecutively, find the day of the week, the day of the month, and the year when number 1 was issued.

MR. PRENDERGAST'S solution.

As a matter of fact, June 8th, 1877, did not fall on *Monday*, but on *Friday*.

Then, if No. 8,505 appeared on Friday, June 8th, 1877, the problem is to ascertain day and date of appearance of No. 1.

In 1,417 weeks there are 3 less than 8,505 working days, ∴ Friday is *3rd* working day of 1,418th week, *i.e.*, No. 1 was published on Wednesday.

No single year contains an *exact* number of *weeks*, consequently the number of working days in a year is not a constant quantity, although varying to the extent of one day.

28 is smallest number of consecutive years that contains an *exact* number of *weeks*, ∴ the number of weeks in any 28 consecutive years is an integer (provided that the *first* year of a century is not one of the 28); and the number of working days in any 28 consecutive years (provided the first year of a century is not one of the 28) is a constant quantity, and is 8,766.

∴ June 8th, 1849, was on Friday.

No. 1 was issued $(8766 - 8505)$ days after this date.

In 43 weeks there are 3 less than 261 working days.

No. 1 was issued 43 weeks and 3 days after June 8th, 1849, or on Wednesday, April 10th, 1850.

No. 48. (No. 87, June, 1895.) A planer is driven by a driving-wheel 20 inches in diameter, and a feed pulley 9 inches in diameter, and has a speed of 900 lineal feet per hour. If the diameter of the driving-wheel be increased 4 inches, and that of the pulley be decreased 4 inches, what will be the speed per hour?

Solution by INCOGNITO.

One revolution of driving wheel causes the feed pulley to revolve $\frac{20}{9}$ times.

When the diameters of these wheels have been changed, a revolution of driving-wheel causes feed pulley to revolve $\frac{24}{5}$ times; the point of contact of pulley is the same as that of planer—900 feet in the first case—, ∴ in second case speed of planer will be $900 \times (\frac{24}{5} \div \frac{20}{9})$, or 1,944 feet.

No. 49. (No. 89, June, 1895.) Suppose a latitude where the acceleration of gravitation is $32\frac{1}{2}$ feet. A stone weighing 10 lbs. is thrown with a velocity of 9 feet per second vertically downwards from a balloon half a mile high, and rising upwards at 50 miles per hour. At what time, with what momentum, and with what velocity will the stone strike the earth?

Solution by MR. PRENDERGAST.

Velocity of balloon $= 73\frac{1}{3}$ ft. per second.
Initial velocity of stone $= -64\frac{1}{3}$ ft. per second.
Terminal   "   "   " $= -64\frac{1}{3} + 32\frac{1}{2}$ t

Mean   "   "   " $= \dfrac{65t}{4} - 64\frac{1}{3}$

$2640 = t \left\{ \frac{65}{4} t - 64\frac{1}{3} \right\}$, $t = 14.87 +$ sec.
Velocity when it reached ground
$= 32\frac{1}{2} \times 14.87 - 64\frac{1}{3}$
$= 418.94 +$ ft. per sec.

Momentum $= 3770.46 +$.

No. 50. (No. 92, June, 1895.) Transform 7304.513 from the octenary to the ernary scale.

Solution by W. PRENDERGAST, B.A.

7304 in scale of 8
$= 7(8)^3 + 3(8)^2 + 4 = 3780$ in scale of 10
$3780 = 3^7 + 2.3^6 + 1.3^4 + 2.3^3$
$= 12012000$ in scale of 3

.513 in ternary scale $= \frac{5}{8} + \frac{1}{64} + \frac{3}{512} = \frac{331}{512}$

$\frac{331}{512} = \dfrac{\frac{331 \times 3}{512}}{3} = \dfrac{1\frac{481}{512}}{3} = \frac{1}{3} +$ etc.

$= .122 1101001112 +$ in scale of 3

∴ 7304.513 in octenary scale
$= 12012000.1221101001112$ in ternary scale.

No. 51. (No. 93, June, 1895.) A person starts with a capital that produces 4 % compound interest; he spends yearly a sum equal to twice the original interest on his capital. Find in how many years he will be ruined.

Solution by W.P.

Let C = original capital, n = number of years.
Then $\frac{8}{100}$C = amount spent each year.

If his capital were invested for n years at 4 % compound interest, it would amount to $C(1.04)^n$.

A person would neither gain nor lose if, instead of paying his debts as they became due, he allowed them to accumulate, and paid interest on them at *same rate* as he was receiving for his capital; the debts of the person in question would, under these conditions, amount, in n years, to

$\frac{8}{100}C \left\{ 1.04^{n-1} + 1.04^{n-2} + \ldots 1.04 + 1 \right\}$
$= \frac{8}{100}C. \dfrac{104^n - 1}{.04}$.

He will then be ruined if his debts amount to as much as his capital, *i.e.*, if

$\frac{8}{100}C \dfrac{104^n - 1}{.04} = C(1.04)^n$

or if $2 \left\{ 1.04^n - 1 \right\} = 1.04^n$
" $1.04^n = 2$
" $1.04^n = 2$
n log. $1.04 = $ log. 2

∴ $n = \dfrac{.301030}{.017033} = 17 +$; *i.e.*, he will be ruined after the 17th year.

PROBLEMS FOR SOLUTION.

SENT BY CORRESPONDENTS.

No. 52. An agent sold a consignment of apples on a commission of 3 %. After deducting his commission and reserving a sum sufficient to pay the freight at 20c. per cwt., he bought flour at $2.80 per cwt. on a commission of $2\frac{1}{4}$ %. The total commission was $63. Find the amount of flour bought.

No. 53. A person invested in 3 % stock so as to receive $5\frac{1}{4}$ % clear on his investment, after paying an income tax of 20 mills on the dollar. What was the market price of the stock, brokerage being $\frac{1}{2}$ %?

No. 54. A sum of money in two years at compound interest, added yearly, amounts to $648.96;

the present worth of the sum for one year is $576\frac{12}{13}$. Find the rate per cent. per annum.

No. 55. $25,000 of bank stock pays 8 % dividend. When money is worth 7 %, this is sold out and proceeds invested in another stock @ 205, which pays a dividend of 12 %. Find the alteration in the income, brokerage $\frac{1}{2}$ % for each transaction.

No. 56. A rectangular field containing 3 acres is surrounded by a road of uniform width of 66 feet, the total area of the road being 3 ac. 36 sq. rods. Find the length and width of the field.

No. 57. A boy dividing a number by factors used 7 for the first divisor and 8 for the second; his first remainder was 1, the second remainder was 5 groups of the size of the first divisor; his quotient was 7,115. Find the divisor.

If the people of a community have no respect for a profession, they will not take very kindly to a votary of that profession, and the social life of said votary will not be enviable in that community. But if teachers had more of an earnest, progressive, *professional* spirit, teaching would not be called, as it is by many, a degraded profession, and the isolation of which so many teachers complain would not be often heard of.

Usually there is not an active sympathy between the teachers in village schools and those in the country schools. Village teachers are apt to look down upon country teachers, and thus there is a barrier between them. But if country teachers were compelled to attend to their professional duties as so many of the village and city teachers are, this barrier would almost totally disappear. To be sure, teachers living in the country cannot have the opportunities for conferring with one another that are enjoyed by their village fellows, but they, many of them, slight opportunities for bettering themselves. And this leads me back to my first statement: they isolate themselves, and are thus to blame.—*George M. Fly, in the School Journal.*

The books we love are friends whose sympathy
Exhaustless flows from fount undrained of Time;
From cosmic history to bard sublime,
The crystal draught of knowledge floweth free.
And we, asearch for wisdom, science, art,
For truth, philosophy—the soul's far quest
Of aught, in worth or choice, divinest, best—
May question of these friends as heart to heart;
With them traverse the earth, the sky, and sea,
In mystic depths profound and isolate,
Or, 'midst the busy scenes of life and fate,
Find in their message truest harmony,
Attuned to all the human soul holds dear
In memory's dim and hallowed atmosphere.
—*Isadore Baker.*

Rev. Edward Thring had a theory upon which he worked. His main principle was simple enough—that every boy is good for something, and that education means to help him to find out what he is good for, and to make the very best of him without making the capacity of one boy the standard of another. The principle sounds almost too obvious for statement. And yet to put it into consistent practice would be to sweep away the very last relic of cram, to change test by examination out of all recognition, and to transform a Public School from a place for polishing exceptionally clever boys into one for making the best of every boy individually, whatever might be the quantity or the quality of his brains.—*New York School Journal.*

"Not only is one man unlike another, but every man is essentially different from every other, so that no training, no forming, nor informing, will ever make two persons alike in thought or in power. Among all men, whether of the upper or lower orders, the differences are eternal and irreconcilable between one individual and another, born under absolutely the same circumstances. One man is made of agate, another of oak; one of slate, another of clay. The education of the first is polishing; of the second, seasoning; of the third, rending; of the fourth, moulding. It is of no use to season the agate; it is vain to try to polish the slate, but both are fitted by the qualities they possess for services in which they may be honored."—*Ruskin.*