Solutions to Missing-Figure Problems

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SOLUTIONS TO MISSING-FIGURE PROBLEMS.

BY W. E. H. BERWICK.

THE SEVEN SEVENS.

125473) 7375428413 (58781.

An excellent detailed solution of this problem, by Mr. J. W. Reid, is to be found in the *School World* of August 1906.

THE FIVE FIVES.

$$\begin{array}{r}
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 \end{array}
 \begin{array}{l}
 (1) \\
 (2) \\
 (3) \\
 (4) \\
 (5) \\
 (6)
 \end{array}$$

(i) Let the divisor be $D \equiv a\beta\gamma\delta$ and the quotient $Q \equiv \epsilon 5\theta$: from lines (4) and (6) θ cannot exceed 4. Since $5 \cdot D \geq 10^4$ and $\theta \cdot D < 10^4$, the following are the limits for D :

$$\begin{array}{ll}
 \theta = 1, & 2000 \leq D \leq 9999; \quad \theta = 3, \quad 2000 \leq D \leq 3333; \\
 \theta = 2, & 2000 \leq D \leq 4999; \quad \theta = 4, \quad 2000 \leq D \leq 2499.
 \end{array}$$

(ii) The limits for line (3), $uv \times \times 5$, are 10005-10995, 19015-20995, 29015-30995, 39015-40995, 49015-50995; and since this line $= 5\theta \cdot D$, the divisor is further restricted, viz.:

	$\theta = 1$	$\theta = 2$	$\theta = 3$	$\theta = 4$
$uv = 10$,	2000-2156,	2000-2115,	2000-2075,	2000-2037.
$uv = 19, 20$,	3726-4117,	3654-4038,	—	—
$uv = 29, 30$,	5687-6078,	—	—	—
$uv = 39, 40$,	7648-8039,	—	—	—
$uv = 49, 50$,	9608-9999,	—	—	—

(iii) Since $5\theta \cdot D$ ends with $5 \times$, from line (3), we have the following possibilities for $\gamma\delta$:

$$\begin{array}{ll}
 \theta = 1, & \gamma\delta = 01, 03, 05, 07, 09, 50, 52, 54, 56, 58; \\
 \theta = 2, & \gamma\delta = 01, 03, 26, 28, 51, 53, 76, 78; \\
 \theta = 3, & \gamma\delta = 01, 03, 18, 35, 50, 52, 67, 69, 84, 86; \\
 \theta = 4, & \gamma\delta = 01, 14, 25, 27, 38, 51, 64, 75, 77, 88.
 \end{array}$$

(iv) Let the dividend be $\lambda 55 \times \times 5 \times$, then, subject to (ii), the limits for the divisor are

$$\begin{array}{ll}
 \theta = 1, & \lambda = 3, \epsilon = 4, 7872-7893; \quad \lambda = 2, \epsilon = 6, 3918-3832; \\
 & \lambda = 1, \epsilon = 7, 2064-2077; \quad \lambda = 4, \epsilon = 7, 6058-6071; \\
 & \lambda = 6, \epsilon = 8, 7696-7708; \quad \lambda = 3, \epsilon = 9, 3733-3743; \\
 & \lambda = 5, \epsilon = 9, 5836-5846; \quad \lambda = 7, \epsilon = 9, 7939-7950; \\
 \theta = 2, & \lambda = 2, \epsilon = 6, 3911-3926; \quad \lambda = 1, \epsilon = 7, 2061-2074; \\
 & \lambda = 3, \epsilon = 9, 3729-3739; \\
 \theta = 3, & \lambda = 1, \epsilon = 7, 2058-2071; \\
 \theta = 4, & \lambda = 1, \epsilon = 7, 2053-2070.
 \end{array}$$

(v) Cutting out from (iv) everything disallowed by (iii), there remain the possibilities, $Q \times D$,

$$\begin{array}{ll}
 951 \times 7950; & 851 \times 7701, 7703, 7705, 7707; \\
 652 \times 3926; & 753 \times 2067, 2069; \quad 754 \times 2064.
 \end{array}$$

On trial only one of these gives $\times 55$, etc., in dividend and $\times \times 5 \times \times$ in line (2). The solution is

$$3926) 2559752 (652.$$

THE THREE THREES.

419) 11313 (27.

27. 419 = 11313.

THE FOUR SEVENS (I).

959 . 713 = 683767,

959) 683767 (713.

253 . 739 = 186967,

253 . 729 = 184437,

253 . 719 = 181907.

THE FOUR SEVENS (II).

337 . 3257 = 1097609,

3257) 1097609 (337.

638 . 1595 = 1017610.

THE SEVEN SIXES.

761) 469272 (616,

Remainder = 496.

THE TWO SIXES.

Let the root be $abcde$, and let the lines be numbered (1), (2), ... (10) in order from the top.

(i) From lines (3) and (4) and the 6 in the root,

$$6(20 \cdot a + 6) < 10^3, \quad 7(20 \cdot a + 7) \geq 10^3,$$

hence $a = 8$.

(ii) Similarly from lines (5) and (6),

$$c(20 \cdot 86 + c) < 10^4, \quad (c + 1)(20 \cdot 86 + c + 1) \geq 10^4,$$

whence $c = 5$.

(iii) Evidently $e = 4$ or 6 , and only the latter satisfies, line (10),

$$e(20 \cdot 865d + e) > 10^7.$$

(iv) Finally $d = 8$ or 9 , for anything else makes line (5) less than 10000. The two solutions are

$$\sqrt{7497135396} = 86586,$$

$$\sqrt{7498867216} = 86596.$$

THE TWO FOURS.

$$\sqrt{3445125204} = 44354 \text{ (vi).}$$

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96. In Sir Andrew Noble's first paper contributed to the Royal Artillery Institution in 1858, entitled *On the Application of the Theory of Probabilities to Artillery Practice*, he used Encke's fundamental formula giving the functional form of a "probable error." Much experimental work was involved. . . . He concludes with the remark: "There is perhaps no branch of mathematics from which more information to practical artillerymen can be obtained than from the Theory of Probabilities."

97. Cornelia, wife of Pompey, whom she survived: "She had many charms apart from youthful beauty; she was well versed in literature, in playing the lyre, and in geometry, and had been accustomed to listen to philosophical discourses with profit. In addition, she had a nature which was free from that unpleasant officiousness which such accomplishments are apt to impart to young women."—*Plutarch*.

98. If the brain of the most stupid peasant were to become like that of Gauss, the peasant would develop into a mathematician like Henri Mondeux or young Colbarn.—*Taine* (in letter to Max Müller). [Calculating prodigies. Zerah Colburn.]