

foot-paths. But if a flanchèd wheel be preferred, then I think the form of the rail in Fig. 2 is better suited to meet the various requirements of the case than any I have yet seen. Each could be made either of wrought or cast iron, and of course of any dimensions to suit the particular traffic. I will not now take up any more of your space or your readers' time by enlarging on the advantage of my proposed plans, but conclude by assuring you that—whether they are novel or not—I shall not patent them, but present them to the public gratuitously.

59 Lee Crescent, Birmingham, May 31, 1860.

For the Journal of the Franklin Institute.

*New Rule for Depths of Keystone for either Segmental or Elliptic Arches of Stone.* By JOHN C. TRAUTWINE, C. E., Philada.

I submit the following original rule for determining the depth of keystone for either segmental or elliptic arches of stone, as coinciding more nearly than any other with which I am acquainted, with the practice of the best engineers :

For first class cut-stone work of hard material take  $\cdot 36$  of the square root of the radius at the crown. For second class work  $\cdot 4$ ; and for brick or rubble arches  $\cdot 45$  of the same square root.

The following examples will show the accordance of the rule with existing structures both elliptic and segmental, in the first case, viz : with first class work and materials.

$\cdot 36\sqrt{\text{Radius at crown.}}$

	Span in feet.	Rise in feet.	Rad. at Crown in feet.	Actual Key in feet.	Calcul'd Key in feet.	Engineer.
Cabin John Aqueduct and Roadway Arch of the Washington Aqueduct,*	220	55 $\frac{1}{4}$	134 $\frac{1}{4}$	4.16	4.17	Meigs.
Grosvenor Bridge, across the Dee, . . .	260	42	140	4.00	4.26	Harrison.
London Bridge (new), Thames, . . .	162	20 $\frac{1}{2}$	162	4.75	4.58	Remie.
Gloucester Bridge, Severn, . . .	150	35	150	4.50	4.41	Telford.
Clair Bridge, France, . . .	150	54	82	3.10	3.26	
Dora, Turin, . . .	148	18	160	4.80	4.55	Moseu.
Neuilly, as designed, . . .	128	32	160	5.30	4.55	Perronet.
Neuilly, as it exists on account of the settle- ment of the arches, . . .	128		250	5.30	5.69	Perronet.
Licking Aqueduct, Ches. and Ohio Canal, . .	90	15	76	2.83	3.14	Fisk.
Staines Bridge, . . .	74	9.3	78	3.00	3.18	Remie.
Bow Bridge, England, . . .	66	13.75	81	2.50	3.24	Walker and Burgess.
Monocacy Aqueduct, . . .	54	9	50.0	2.50	2.55	Fisk.
Lugar Viaduct, Scotland, . . .	50	25.00	25.0	2.00	1.80	Miller.
James River Aqueduct, . . .	50	7	47.0	2.66	2.47	Eller.
Reading Railroad, at Reading, . . .	31	5	29.8	1.66	1.86	Steele.
Semi-circle, . . .	2.0	1.00	1.0		0.33	
Pont Napoleon Viaduct, Paris, small rubble masonry in cement: multiply by $\cdot 45$ , . . .	115.5	14.75	120	4.00	4.93	Conche.
Maddenhead Viaduct, brick in cement: mul- tiply by $\cdot 45$ , . . .	128	24.25	160.0	5.25	5.85	Brunei.

Our public works abound with cut-stone arches having keys varying from  $\cdot 36$  to  $\cdot 4$  of the square root of the radius of the crown, and with rubble arches having keys from  $\cdot 4$  to  $\cdot 45$  of the same square root; but I have not thought it necessary to introduce them.

\*This is the largest stone arch of modern times, or, perhaps, of any former period, unless we except the ancient bridge of Trezzo, said to have been 251 feet span; it was designed, and its erection superintended by Capt. Montgomery C. Meigs, of the U. S. Topog. Engineers.