

Taking the *Century* for April, which is the last I have, and which represents all, or nearly all, the stages of assisted work, it is impossible not to recognize the sterling value of process in such reproductions as the portrait of Admiral Montojo and that of Gen. Greene, but nothing outside of bare necessity makes the portraits of Merritt and Chadwick permissible; while if we take the best of the mixed plates, that of the portrait of Dewey, and compare it, simply as rendering of flesh, and luminous tint, suggesting at least the luminousness of the flesh, with the head by Cole in a previous number, the "Parson's Daughter" after Romney, it will be seen that the difference is radical. The luminousness of the pure line, pure black in immediate contact with pure white, is not to be attained by any graduation of tint which does not give it. The only question, and this is one which only the engraver, himself can fully answer, is how far the process basis could be made use of in the production of line work like that of the Cole block. If the process gradation appear at all in the finished work, it seems to me to mean so much loss of quality; if it does not appear, it is hard to see what advantage the use of process has over the former method of working on a photographic reproduction on the block, which is that of the Cole cutting. To my taste, the "Parson's Daughter" is the most exquisite example of pure line in a head that I know of in contemporary work, and if process is going to make such engraving unattainable by lowering the technical education of our future engravers, it will be a misfortune with no adequate compensation.

And, by the way, it is a matter of interest to inquire how the mixed style is going to affect the absurd decision of our Treasury, which classes wood blocks as carved wood at 30 per cent. duty, while it permits a stereotype plate, which the engraved process plate is, to come into the United States free of duty. According to the sapient logic of our Treasury, if Mr. Cole can manage to do all his work on a process plate, he can escape the duty which now prevents his sending his large blocks to be printed in America. As he still holds to his purpose of bringing out the large engravings from the old Italian masters of which there was mention in the *Nation* several years ago, this question may be important to him and us.—Yours truly,

W. J. STILLMAN.

CONDERCUM, W. BOURNEMOUTH, ENGLAND.

#### GALILEO'S REASONING.

TO THE EDITOR OF THE NATION:

SIR: Galileo endeavored to show by a *priori* reasoning that the velocity of a falling body cannot be proportional to the distance fallen. In my 'History of Physics' I adopt the view that Galileo's argument on this point is illogical. Your reviewer of my history tries to show (p. 317) that Galileo's reasoning is sound; but I cannot accept his position. Galileo says:

"If the velocity with which a body overcomes four yards is double the velocity with which it passed over the first two yards, then the times necessary for these processes must be equal; but four yards can be overcome in the same time as two yards only if there is an instantaneous motion."

To test these assertions, we express Galileo's assumption by the formula:

$$\frac{ds}{dt} = v = as,$$

where  $a$  is some finite constant (not zero).

If it is possible for  $s$  to attain a finite value, then we see from this formula that the velocity is finite. Therefore, having a finite velocity, the body cannot pass from two yards to four yards *instantaneously*. Hence, Galileo's conclusion does not follow. The reason why the reviewer finds the time for this passage to be zero is because (contrary to Galileo's hypothesis) he assumes *this time to be zero*.

As a matter of fact, the distance  $s$  can never attain a finite value. The correct conclusion to be drawn from Galileo's assumption is that the body *can never begin to move*. Since Galileo concludes that instantaneous motion is the result when really there can be no motion at all, his reasoning is fallacious.

FLORIAN CAJORI.

[Galileo's reasoning (which, by the way, is not, properly speaking, *a priori*) was intended to refute the hypothesis that the velocities of a falling body at different times are proportional to the spaces described from a state of rest. This it did by showing that that hypothesis, conjoined with the indisputable facts that neither the time occupied in falling a finite distance nor the velocity acquired is infinite, constitutes an absurdity—that is to say, leads logically to contradictory results. We gave a conjectural restoration of the complete argument of the youthful Galileo, which in his extreme old age he but imperfectly indicated (*Opere*, 1842-56, vol. xiii., p. 161), and remarked that, so understood, it involved no logical flaw.

It is this assertion that Prof. Cajori disputes. When a disputant says an opponent's argument involves a fault of logic, it is his duty to point out clearly just wherein that fault consists. Prof. Cajori does not do this when he says that the reason we find the time to be zero is because we assume the time to be zero, for we made no such initial assumption, but only proved it must be so according to the hypothesis, if the whole time of fall is not infinite.

In that proof Prof. Cajori, it seems, can find no flaw. But he offers two arguments to show that such a flaw there must be. The first of these consists in showing that the hypothesis leads to a conclusion contrary to that which Galileo deduces from it. This, however, would prove Galileo's reasoning wrong only on the assumption that the hypothesis is not one of those from which contradictory conclusions can be correctly deduced; that is, it shows that Galileo's reasoning is wrong only in case Galileo's conclusion that the hypothesis is absurd is wrong. Thus, Prof. Cajori's first argument is a *petitio principii*.

His other argument is, that Galileo's reasoning must be fallacious because quite a different absurdity can be deduced from the hypothesis. This would be good reasoning only if an absurd hypothesis could lead to but a single absurd consequence. Now, this is never the case.

Every mathematician knows that the

solution of the differential equation

$$\frac{ds}{dt} = as$$

is  $s = Ce^{at}$ . In order that  $s$  and  $t$  should both be zero together,  $C$  must be infinitesimal. Then, for a finite value of  $s$ , either  $a$  or  $t$  must be infinite. That is, either the acquired velocity or the time of fall must be infinite. Galileo's argument first adduces the fact that the time is finite, and on that assumption concludes that the hypothesis would involve an infinite acquired velocity, which is absurd. Prof. Cajori says this argument is illogical, because the true logical procedure is first to adduce the fact that the acquired velocity is finite, and on that assumption to show that the time of fall is infinite, which is absurd. The truth is, that these two arguments entirely agree and support one another, and must stand or fall together; so that Prof. Cajori's second argument only goes to show that Galileo's reasoning is correct, while his first argument in no degree impugns it.

We must not be understood as acknowledging the logical accuracy of Prof. Cajori's remarks in points which, for brevity's sake, we leave unnoticed.—  
ED. NATION.]

#### Notes.

Small, Maynard & Company, Boston, announce that Mr. Dunne's new book, 'Mr. Dooley: In the Hearts of his Countrymen,' will be published by them next September, and 'The Dreyfus Case,' compactly presented by Richard W. Hale, a lawyer of Boston.

Lee & Shepard, Boston, announce for the early fall 'For Love's Sweet Sake: Selected Poems of Love in All Moods,' edited by G. Hembert Westley; and 'Camping on the St. Lawrence; or, On the Trail of the Early Discoverers,' a boy's book, by Everett T. Tomlinson.

Drexel Biddle, Philadelphia, has in press Ouida's 'La Strega'; a translation of Maupassant's 'Strong as Death,' by Teofilo E. Comba; 'An Atlantic Tragedy,' by W. Clark Russell; and 'Arctic Romances,' by Albert White Vorse, a member of Lieut. Peary's expedition in 1892.

Additional announcements from D. Appleton & Co. are 'A History of the American Nation,' by Prof. A. C. McLaughlin—the first volume in the new "Twentieth Century Series"; 'A History of Bohemian Literature,' by Count Litzow, in the "Literature of the World Series"; and 'Idylls of the Sea,' by F. T. Bullen.

'A Princess of Vascony,' by John Oxenham, will be published by G. W. Dillingham Co.

Mr. J. C. L. Clark's 'Two Summer Island Papers,' in preparation by C. de Hasbrouck, Boston, will contain sixteen pictures from photographs and old prints, and an historical map.

Lawrence & Bullen, London, who recently published 'From Cromwell to Wellington,' are about to issue a companion volume, 'From Howard to Nelson: Twelve Sallors.' The general editor is Prof. J. Knox Laughton, assisted by Vice-Admiral Sir

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