or, if the sine functions be eliminated by means of (11),

$$\alpha_1 : \alpha_2 : \alpha_3 = \lambda_1(p_2 p_3)^t : \lambda_2(p_3 p_1)^t : \lambda_3(p_1 p_2)^t. \quad (53)$$

While (52) does not enable us to construct the point of least attraction, it furnishes a solution of the converse problem: to determine the ratios of the masses of three points so as to make the sum of their attractions on a point $P$ within their triangle a minimum.

If, in (50), we put $n = 2$ and $\alpha_1 + \alpha_2 = 1$, and hence $p_1 + p_2 = 1$, this equation can be regarded as that of a curve whose ordinate $s$ represents the sum of the attractions exerted by the points $e_1$ and $e_2$ on the foot of the ordinate. This curve approaches asymptotically the perpendiculars erected on the vector $(e_1 - e_2)$ at $e_1$ and $e_2$; and the point of minimum attraction corresponds to its lowest point. Similarly, in the case $n = 3$, the sum of the attractions exerted by the vertices of the triangle on any point within this triangle can be represented by the ordinate of a surface, erected at this point at right angles to the plane of the triangle. This suggestion may here suffice.

22. *Concluding remark.*—Further results concerning generalizations of the problem of the minimum sum of distances are reserved for a future communication.

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# WAS THE BINOMIAL THEOREM ENGRAVEN ON NEWTON'S MONUMENT?

BY PROFESSOR FLORIAN CAJORI.

Moritz Cantor, in a recently published part of his admirable work, *Vorlesungen über Geschichte der Mathematik*, speaks of the " Binomialreihe, welcher man 1727 bei Newtons Tode . . . eine solche Wichtigkeit beilegte, dass man sie aus allen anderen Leistungen des Vestorbenen auswählte, um als Inschrift auf seinen Grabstein in der Westminsterabtei eingemeisselt zu werden" (vol. III, p. 65). In my own brief *History of Mathematics*, p. 218, I say that it is *not* true that the binomial theorem is engraved on Newton's monument.

The above passage in Cantor's work leads us to re-examine the subject    The first step naturally is to question the monument, but we do so in vain. Says Dr. Granville, the present Dean of Westminster, in a letter to the writer: " In front of the half-recumbent figure of Sir Isaac Newton are two winged youths holding a small scroll in which are still, according to Neale, some mathematical figures. . . . I fear that the figures on the small marble scroll are *quite obliterated.* A mathemat-

ical friend mounted the monument for me. Time, I fear, and London atmosphere have done their sad work, and the older guide-books, Dart and Neale, while they carefully copy other inscriptions, naturally do not preserve for us mathematical formulæ." A friend of the writer of this article reports, "I looked as close as a chair would permit and saw no sign of engraving on the scroll."

Our American cyclopædias, almost without exception, assert that the Binomial Formula is engraven on Newton's tomb or his monument. This assertion is supported by an author who wrote only sixteen years after Newton's death. In the *New Mathematical Dictionary* by E. Stone, F.R.S., Second Edition, London, 1743, under "Binomial Root," we read, "This admirable theorem, which is put upon his monument in Westminster Abbey, has never been yet demonstrated."

Had the inscription ever been made, then the general interest attached to it would tempt mathematical writers and biographers to speak of it. Now the very fact that all authoritative writers on Newton, including those most likely to know from personal observation, are silent on this subject (though they frequently take pains to copy the Latin inscriptions), leads us to the conclusion that the theorem was never engraven. This inference has been drawn after the examination (either by the writer or by friends) of the following works: "Life of Newton" in the Biographia Britannica (1760), Maclaurin's Exposition of Sir Isaac Newton's Philosophical Discoveries (1775), Maclaurin's Treatise of Fluxions (1742), Maclaurin's Treatise of Algebra (1779), Horsley's edition of Newton's works (1779–85), Saunderson's Algebra (1740), Hutton's Philosophical and Mathematical Dictionary (1796), Biot's article "Newton" in Biographie Universelle (1822), Arago's Notices Biographiques (1855), Life of Newton in the Library of Useful Knowledge (1833), the 8th and 9th editions of the Encyclopædia Britannica, the histories of mathematics by Montucla, Bossut, Arneth, Ball, Marie, Hoefer, and Fink.

While guide-books naturally would not copy formulæ, we should rather expect the old guides of Westminster Abbey to mention the name "Binomial Theorem," had the theorem been inscribed on Newton's tomb or monument.

Dean Stanley, in his *Historical Memorials of Westminster Abbey*, 1876, says nothing of the binomial theorem, though he quotes even passages which were *proposed* for inscription upon the monument and tomb, but which were rejected. "On the gravestone (restored to its place in 1866) are written the words which here acquire a significance of more than usual solemnity—' Hic depositum quod mortale fuit Isaaci Newtoni ' " (p. 314).

David Brewster, in his *Life of Sir Isaac Newton*, 1831,

says, " On the sarcophagus is placed the figure of Sir Isaac
Newton in a cumbent posture, with his elbow resting on sev-
eral of his works. Two youths stand before him with a scroll,
on which is drawn a remarkable diagram relative to the solar
system, and above that is a converging series." Brewster
would surely have said " binomial theorem " instead of " con-
verging series," had the theorem been there.

In the article " Newton " in the *Penny Cyclopædia* (1840)
we read, " It is not true that the binomial theorem is also
engraven upon it [the monument], though it is so stated
under ' Binomial Theorem,' on the authority of several
writers." Now all mathematical articles in this cyclopædia
are De Morgan's. From the numerous cross-references to
mathematical articles made under " Newton " and the absence
of references to other articles (such as " Light " and " Gravi-
tation," not written by De Morgan), as well as from other
considerations, we infer that the article " Newton " is De
Morgan's also. Remembering his accuracy in details, much
weight must be attached to this denial. The above passage is
reprinted in the *English Cyclopædia* (with the omission of
three words), while under " Binomial Theorem " we read, " It
is often said, but wrongly, to have been engraven on his tomb
in Westminster Abbey."

Thus it appears pretty conclusively that there is no more
foundation for the statement that the Binomial Theorem was
inscribed on Newton's tomb or monument than there was
authority for the story of the " apple " or for the use of the
word *fluxion* and the notation $\dot{x}$ by all English writers previ-
ous to 1704 (excepting Newton and Cheyne) and by Stone in
1743, in the sense of an infinitely small increment.

## NOTES.

A REGULAR meeting of the AMERICAN MATHEMATICAL SO-
CIETY was held Saturday afternoon, October 27, at three
o'clock, the President, Dr. McClintock, in the chair. The fol-
lowing persons, having been duly nominated and being recom-
mended by the Council, were elected to membership: Miss
Charlotte Cynthia Barnum, New Haven, Conn.; Professor
Robert Lee Flowers, Trinity College, Durham, N. C.; Mr.
George H. Hallett, University of Pennsylvania, Philadelphia,
Pa.; Mr. Edgar Odell Lovett, University of Virginia, Char-
lottesville, Va.; Mr. Elmer A. Lyman, University of Michi-
gan, Ann Arbor, Mich.; Mr. Max Osterberg, Columbia College,
New York, N. Y.; Dr. James P. Pierpont, Yale University,
New Haven, Conn.; Mr. Ralph Augustus Roberts, New York,
N. Y.