Simultaneous Differentials (or *Corresponding Fluxions*) are *Limits of Equimultiples of Simultaneous and Decreasing Differences.*

As we have seen, Newton also made this definition in "Quadrature of Curves," essentially as Hamilton gathered it from the "Principia." Many better mathematicians than myself, or than Professor Huntington, have, in fact, examined this definition carefully, and have found it to be rigorous, simple, and of great generality.

The infinitesimal method of Leibniz is to be found essentially in Newton's first tract "De analysi per aequationen . . .," which Newton himself later rejected as illogical. A third method of explanation is that of Lagrange, which consists in assuming (for independent variables), $dx = \Delta x$, $dy = \Delta y$, and for a dependent variable z $dz =$ *principle part of* Δz, which Lagrange proposed to determine as *the terms of first degree in the expansion of* $z + \Delta z$ *in ascending powers of* Δx, Δy. Newton's dz is the same, if we put $dx = \Delta x$, $dy = \Delta y$. The adoption of the derivative method, led to devices to obtain the same significance of dz by derivatives, without assuming expansions in series. These involve various logical difficulties, especially when there are several independent variables. Also the differentials appear to change their values by changing the independent variables, whereas, Newton's method shows that for every equation between the variables, there exists (if differentiation be possible) a definite corresponding equation between their differentials, irrespective of the choice of independent variables.

Unquestionably, there has been a long continued propaganda, fostered at bottom to protect the claims of Leibniz, and aided by the inertia of established usage, to keep the methods of Newton in abeyance. Imagine, if the nationalities of these men had been reversed, the number of pamphlets that would have exploited the matter, and the number of textbooks in that method which would years ago have been published.

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CARBON DIOXIDE AND INCREASED CROP PRODUCTION

TO THE EDITOR OF SCIENCE: In 1912, at the International Congress of Chemists held in New York, Professor Ciamician, of the University of Bologna, presented a paper on the "Photochemistry of the Future," in which, among other things, the suggestion was made that crop production might be increased by increasing the concentration of carbon dioxide in the air. Of course, the idea underlying such a suggestion is that since the carbon dioxide of the air is a necessary constituent in the synthesis of carbohydrate by the plant, and since, furthermore, the percentage of the gas in the air is comparatively small, any increase in the amount of carbon dioxide may tend to increase the amount of carbohydrate produced.

That such is actually the case has been found by a number of German chemists, according to the Berlin correspondent of the *N. Y. Tribune* (April 4). Working in greenhouses attached to one of the large iron companies in Essen, and utilizing the carbon dioxide (freed from impurities) obtained from the blast furnaces, the yield of tomatoes was increased 175 per cent. and cucumbers 70 per cent. Further experiments in the open air, on plots around which punctured tubes were laid, and through the latter of which the carbon dioxide was sent, gave increases of 150 per cent. in the yield of spinach, 140 per cent. with tomatoes and 100 per cent. with barley.

BENJAMIN HARROW

STRUCTURAL BLUE IN SNOW

TO THE EDITOR OF SCIENCE: The recent blizzard began here with a heavy downpour of rain on the evening of March 5, which later turned into a glistening snow that was shattered by the furious wind and formed a crystalline-looking glittering coherent mass whose structure was maintained by the low temperature (about 20° F.).

When the sun finally came out on Saturday afternoon, I noticed that the shadows of the trees and the shadow masses of the distant snow, appeared unusually *blue*, and that the snow itself looked blue-white, like paper or sugar "blued" with ultra marine. Evidently the snow, because of its structure, reflected a larger proportion of the short wave-lengths of blue; and we have here another illustration of a structural blue color, which, according to Wilder D. Bancroft "may be obtained when we have finely divided particles of liquid or solid suspended in a gaseous medium (blue of the sky) or a liquid medium (blue of the eye or of the tree-toad); or when we have finally divided air-bubbles suspended in a liquid or solid medium (blue feathers).[1]

Incidentally there is some justification for the somewhat brilliant blues used by the artists in painting snow scenes, especially in the shadows; and we recall the story told of Whistler, who, when a lady visitor at his exhibition remarked, "I've never seen a sunset like that, Mr. Whistler," promptly replied, "Well don't you wish you could?"

JEROME ALEXANDER

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[1] See "The Colors of Colloids," VII., *J. Phys. Chem.*, Vol. 23, pp. 365–414.

SCIENTIFIC BOOKS

How to Make and Use Graphic Charts. By ALLAN C. HASKELL, B.S., with an introduction by RICHARD T. DANA. 539 pages. First edition. Price $5.00.

The last years have seen a tremendous progress in the application of graphic methods and while these methods must be regarded as means rather than as ends they nevertheless play a most important part of scientific analysis.

To most persons except the trained engineer, biologist or statistician the principles of analytic geometry which are the basis of most graphic methods appear too difficult and intricate as that they would be used for practical problems of every-day life.

Mr. Haskell's book fills therefore a distinct demand when it contributes to a clear understanding and wider application and recognition of the graphic method. The treatment is written from the standpoint of the practical engineer who comes daily in contact with such problems which will lend themselves to the application of this form of analysis.

The 539 pages of the richly illustrated book are divided into 18 chapters which go exhaustively into every phase and detail of the possibilities and applications of graphic analysis. Special consideration is given to the current engineering problems of to-day. One whole chapter is devoted to the nomographic or alignment chart. This subject is treated in Chapter VIII. and taken up again in Chapter XVI., "Computation, arithmetical and geometrical" which devotes some thirty pages to this interesting subject.

The author deserves much praise for faithfully collecting the manifold material on this subject. On page 348 however I think it would be worth while to mention the graphic calculation of the polytropic curve based on the equation

$$(1 + tg\beta) = (1 + tg\alpha)^n.$$

The lack of space prevents a longer explanation but for the rapid design of isothermal and adiabatic curves in connection with combustion engine design, this method[1] is extremely valuable on account of its accuracy, rapidity and range covering all exponents $n = 1.10$ (isothermal) to 1.41 (adiabatic).

Chapter VII. would have had room for the smelting diagrams of Stead and Saklatwalla[2] and of Shepherd.

Chapter XVII. is devoted to the graphic methods of designing and estimating. The civil engineer will find much of value and interest here. I think however the chapter could be extended to the advantage of the mechanical engineer and his problems.

The wealth of references relating to the graphic methods which are given at the end of each chapter and which have been collected by Mr. Haskell make the book valuable as a source of information, in short the author has responded to a vital demand for a practical book, "How to make and use graphic charts." The practical man will find much material ready for use and easily understandable and

[1] E. Braner, *Z. d. v. d.*, I., 1885, p. 433.

[2] *Journal of the Iron and Steel Institute*, 1908, No. 11, p. 92.