Nomography and Nomograms (Nomographs)

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A Historical Note

When Descartes invented Coordinate Geometry, he put at the disposal of knowledgeable mathematicians a powerful weapon that had led to phenomental advances in all branches of mathematical science. For the purpose of practical use in calculations by means of graphical representation on a two-dimensional plane, the number of variables that can be used is obviously restricted to two. This limitation was removed by Buache (1752), whom introduced the method of contours---now incorporated in all atlases and surveys. By utilization of contours it is possible to deal with three quantities at once, while they are all represented on one two-dimensional plane, for example, indicating the variation in height of land, or the depth of the sea (on the same chart). This seemed to suffice for a time; however, the extraordinary growth of the steel horse or railway systems all over the world led to important developments by Lalanne(1841), Massau (1884), and Lallemand(1886). Building on these developments was a Frenchman named ***Maurice d'Ocagne***. The idea of using collinear points and parallel natural and lograthmetic scales to describe mathematical relationships was developed by d'Ocagne (1884). It was d'Ocagne, too, who applied the name "Nomograph" to this method, in his book ***"Les calculs usuels effectu'es au moyen des abaques"*** *(1891)*. Since then further extensions have been made by d'Ocagne and others.

The graphical representation of a mathematical relationship between two variables of the form $y=f(x)$ or $F(x,y) = 0$ generally presents no difficulty. It is merely necessary to find a certain number of pairs of values (x_1,y_1), (x_2,y_2).....which will satisfy the given relationship. These pairs of values are the coordinates of points, M_1, M_2..... referred to as a pair of axes. By joining these points M_1,M_2.....in a continuous curve, the graphical representation of the given relationship is obtained. The only point requiring some degree of care is the graduation of the coordinate axes. An appropriate scale must be choosen in order that the points (x_1,y_1), (x_2,y_2).....determined by the computed values may be plotted with these axes. The choice of scales, their type and the graduation of the coordinate axes depend on several factors, thus the science of "NOMORAPHY" was borne.

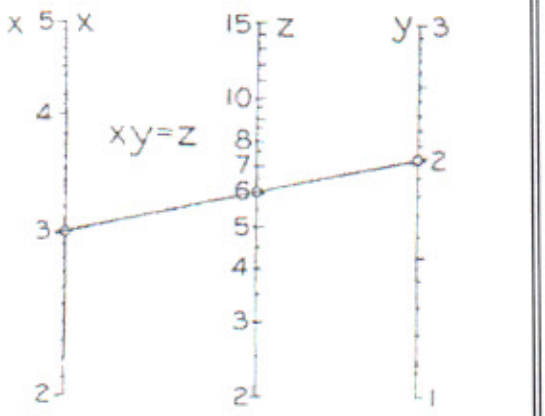
Nomography, known in the "Webster's" international dictionary as ***the science of constructing nomographs*** is what this treatis is all about. Nomographs or nomograms according to the same source are defined as "***an arrangement of two linear or logarithmic scales such that an intersecting straight line enables intermediate values or values on a***

third scale to be read off".

Nomograms, sometimes referred to as alignment charts, are graphical calculators that are closely related to the old-fashioned slide rule. Before the advent of handheld calculators, they were extensively used by engineers for design calculations. Despite the rapid advance of computational power, they are still of practical use in situations where it is convenient to be able to refer to typical values of the important parameters in the units most commonly employed for specific technical disciplines.

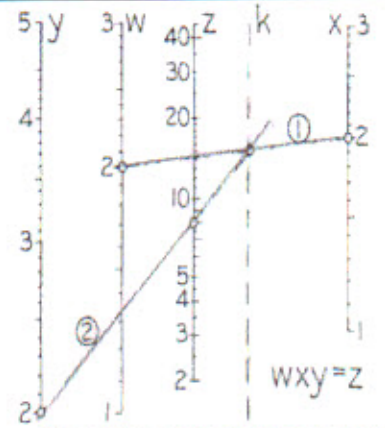
With the current availability of high speed multi-tasking computer systems, there has been a decline in reliance on graphic methods for the solution of linear and logarithmic equations, and the materials in this treatis are mostly unknown to the current generation of scientists. In engineering, graphic presentations have long been important tools, and they still serve important roles in many scientific disciplines today.

The purpose of this treatis is to describe to the reader what Nomography "is" and some of the "basic types" of Nomograms that can be made. There is an extensive reference section at the end of this treatis of which the reader is encouraged to search out and read on thier own for an in-depth discussion on the actual construction of various types of Nomograms. For the general laypersons information there are eight basic types of Nomograms of which are presented below and their associated functions.



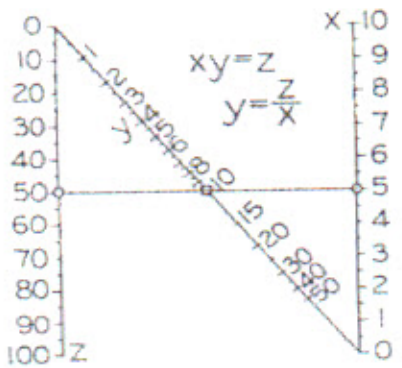
(A) PARALLEL SCALE CHART

f(x) + or - f(y) = f(z) Natural Scales
f(x) f(y) = f(z) Log Scales



(B) PARALLEL SCALE CHART

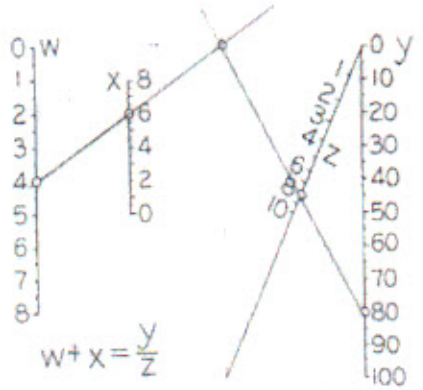
f(w) + or - f(x) + or - f(y) = f(z) Natural Scales
f(w) f(x) f(y) = f(z) Log Scales



(C) "N" OR "Z" CHART

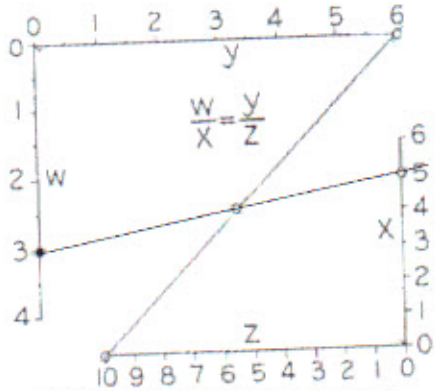
f(x) f(y) = f(z) Natural Scales

$$f(x) = \frac{f(z)}{f(y)}$$ Natural Scales



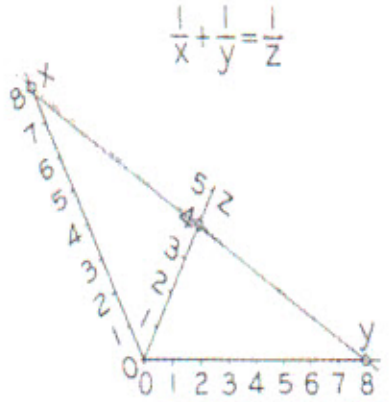
(D) COMBINATION PARALLEL SCALE AND "N" OR "Z" CHART

$$f(w) \text{ + or - } f(x) = \frac{f(y)}{f(z)}$$ Natural Scales



(E) PROPORTIONALITY CHART

$$\frac{f(w)}{f(x)} = \frac{f(y)}{f(z)}$$ Natural Scales



(F) CONCURRENT SCALE CHART

$$\frac{1}{f(x)} + \frac{1}{f(y)} = \frac{1}{f(z)}$$ Natural Scales