W. H. McWhinney

On the Geometry of Organizations

In the era of scientific management and increasing rigor in the social sciences, there has been wide appeal in the idea that a simple geometric model could provide predictive *and* prescriptive *information on the growth and design of social and economic organizations. And in the recent years that have seen the development of* organic *and* open system theories *of organizational behavior, the idea of* biological *geometries and related biological notions such as "homeostatic equilibrium" have been increasingly used by the social scientists to construct their models. The new behavioral scientists and organizational theorists have been particularly attracted to this course by the chance to legitimize their activity since it leads readily to quantification. Increasingly, attempts are being made to find empirical data which will support analogies to phenomena well established in the biological sciences. In the rush to become quantitative—and thus scientific—leaps of fancy have been taken to explain data generated from all kinds of economic, social, and political organizations.*

In this paper, the writer reappraises some attempts to fit empirical data derived from organizational statistics to biological and geometric models. The purpose is not so much to compare one analogy with another, as it is to suggest there is a lack of evidence for these biological or geometric analogies.

William H. McWhinney is assistant professor of organizational behavior at the Graduate School of Business Administration, University of California, Los Angeles.

THE "SHAPE" OF AN ORGANIZATION

IN a widely cited article, Mason Haire[1] proposed, among other geometric models, that organizations might have bodily properties and growth characteristics typical of the biological world. He suggested that the relation of measures of the surface and the interior of an organization would be the same as the relation of the surface and interior of a compact solid. In the surface component (E) he classified all those whose job titles indicated they worked primarily with persons outside the organization. The interior component (I) included all those whose organizational life was spent primarily in contact with other members of the organization. Specifically he proposed that as the firm or organization grows, the ratio between the *square root* of the exterior component, and the *cube root* of the interior component, will remain nearly constant as given algebraically in equation (1) in the next section. Haire tested the validity of his hypothesis with employment data from the history of four firms, going back as far as 35 years in one case. He conducted the tests in the following manner. First he divided the members of the organization into the two components according to their job description or department titles. This simple classification clearly introduced some error, particularly in dealing with the small firm, in which some individuals served more than one function, but it appears adequate for his intent. Next he transformed the data by taking the square root of the exterior count, and the cube root of the interior count; and finally he calculated the regression line for the least-square fit and tested the assumption of linearity by the significance of the correlation coefficients. In all four cases r equalled or exceeded 0.95. He noted that the slopes of the regression line were not 1.0, as would be consistent with the hypothesis, but 0.72, 0.51, 0.50, and 0.97. Furthermore, he noted that the intercept of the regression line was not at the origin. The high degree of correlation seemed to satisfy him as to the validity of the biological model; he reported slight difficulty in developing an *ad hoc* explanation of the disconfirming aspect of the regression equations.

Since the appearance of Haire's article, two other empirical

[1] Mason Haire (ed.) *Modern Organization Theory* (New York: John Wiley, 1959).

studies have been published that relate to this model.[2] The data from all three studies are treated in this paper.

ANALYSIS OF HAIRE'S DATA

Haire's proposition was reviewed by reanalyzing the internal-external data of the four companies Haire treated as well as four others on which he had collected data and classified the employees. A general exponential model was used to retest the validity of the specific square-cube model. The same tests were also applied to the other two studies.[3]

Before Haire's central hypothesis was tested directly, the data were inspected for obvious contradictory evidence by plotting a scattergram of the raw data, and as it seemed appropriate, running linear regression lines (see Figure 1). Six of the eight companies, including all four of those companies appearing in the Haire article, displayed growth rates in the two components such as to produce very strong linear relations. Two firms, labeled E and F, showed remarkable linearity with correlation coefficients in excess of 0.95. Four others displayed similarly strong linearity when an occasional deviant point was ignored. The intercept of the regression line on the untransformed data for seven of the eight firms is within an insignificant distance of the origin, as is appropriate. The slope (E/I) of the regression lines varied from 0.08 to 0.59 for these seven firms.[4] Firm O presented no significant trend and showed a wide dispersion of ratios over the years. Even without further investigation, it is hard not to prefer, on ground of simplicity alone, the simpler hypothesis of proportionate growth to the biological square-cube relation. But a stronger argument against this biological analogy can be presented.

Formally Haire's hypothesized relation is expressed in the following equation:

[2] Seymour Levy and Gordon Donhowe, Explorations of a Biological Model of Industrial Organization, *Journal of Business,* 35 (October 1962), 335–342; Jean Draper and George Strother, Testing a Model of Organizational Growth, *Human Organization,* 22 (1963), 180–194.

[3] Levy and Donhowe, *op. cit.*; Draper and Strother, *op. cit.*

[4] In the constant-ratio model, the slope defines the expected ratio between the number of external and internal employees. In the square-cube transformation, the slope is not so interpretable.

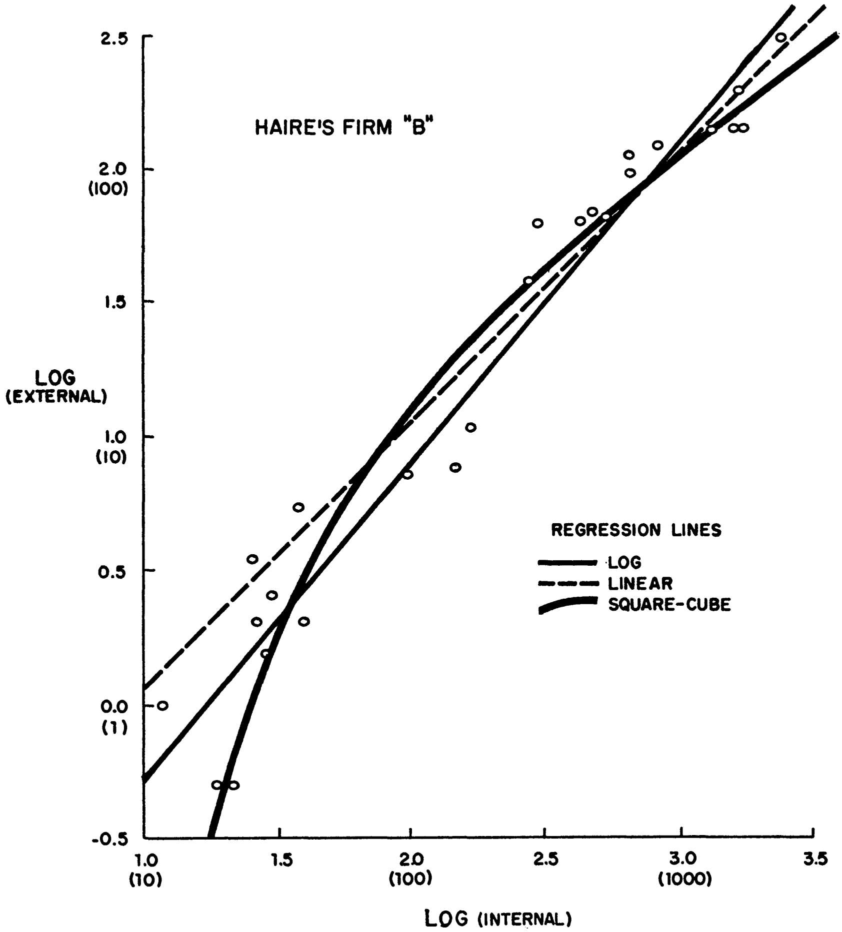

Figure 1. External vs. internal components of the firm: a comparison of the fits to logarithmic, linear, and square-cube models. (The logarithmic representation was chosen over the linear display because of the extreme range of the data. Figures in parentheses are numbers of employees.)

$$E^{1/2} = a + b(I)^{1/3} \quad (1)$$

where E = the number of external employees,

I = the number of internal employees,

b = the rate of change of one variable with the other, and

a = the intercept: the value of E when $I = 0$.

On common sense grounds, as Haire recognized, a must be zero, if sampling errors are ignored. For the biological model to be maintained, b must not differ significantly from unity. Thus with a assumed and empirically noted to be zero, equation (1), with simplification and redefinition of the coefficient b, becomes

$$E = b\ (I)^{2/3} \tag{2}$$

To allow testing of this hypothesis with the simple tools of linear regression, can apply a logarithmic transformation to equation (2) and to the data. Thus equation (2) reads

$$\log E = \log b + c \log I \tag{3}$$

and Haire's hypothesis is that the slope $c = 2/3$. The secondary hypothesis, that $\log b = 0$, need be tested only if the fundamental hypothesis holds.

The logarithmic transformation has a minor disadvantage, for it gives proportional weight to the small error-laden figures, whereas regression with the raw data minimizes the effect of these errors. But there is advantage to using the logarithmic transformation, since it does not require the assumption of a particular proportional growth ratio. Rather it makes accessible an estimate of this growth parameter, which is useful in a more general growth model presented later.

A least-square regression equation was calculated for each of the eight companies and a two-tail Student's test was run to determine the likelihood that the sample growth parameters, c_i, could be from a population of organization characterized by $c = 0.667$. For seven of the eight companies, this hypothesis could not be maintained, as Table 1 shows in detail. Thus on the basis of Haire's longitudinal data, there appears to be *no evidence to support the square-cube biological-growth analogy*. The aspect of the data which does nevertheless require some sort of explanation, is the constancy of the parameter c, or rather the high correlation, in seven of the eight firms. Discussion of this datum will be postponed until the remainder of the empirical data published on this model is reviewed in the discussions of generalized growth models.

Table 1. Regression equations and significance data for Mason Haire's firms.

Firm	Observations (annual where available) N	Regression equation (log transformation) E	r	Student's t*	Regression equation for principal *linear* trend† E
B	25	$0.032\ I^{1.19}$	0.95	4.90	$0.11\ I$
C	14	$0.048\ I^{1.68}$	0.97	8.48	$0.18\ I - 3.$
E	32‡	$0.037\ I^{1.0}$	0.90	3.50	$0.41\ I$
F	17	$0.29\ I^{0.86}$	0.93	2.12	$0.11\ I + 3.$
J	37	$0.37\ I^{0.94}$	0.96	6.37	$0.22\ I + 3.$
K	40	$0.65\ I^{0.96}$	0.87	3.05	$0.59\ I$
M	15	$0.28\ I^{0.82}$	0.97	2.07	$0.08\ I$
O	43	$37\ I^{-0.01}$	0.062	2.20	none

*Calculated against the hypothesis that $c = 0.667$. For all firms except M the likelihood of the firm being from a universe of $c = 2/3$ is less than 0.05 based on a two-tail test, d.f. $= n - 2$. For M, $p \cong 0.07$.

† Trend computed after off-trend observations were deleted by visual inspection. Only firm J had a significant number of deleted points—14. Of these, 10 are for the most recent years and form a second trend with zero slope.

‡ The first 5 of 37 observations werl ignored as the classification placed all employees in interior of the firm.

The Levy-Donhowe Data

Following Haire's lead and method, Levy and Donhowe[5] presented a *cross-sectional* study of the internal-external makeup of 62 firms in eight manufacturing industries. Their data consisted of the component employment for each firm recorded at approximately the same time. Their analysis, while superfically similar to Haire's, introduced some additional problems in testing the model. They concurred with Haire's conclusion, saying, the "Square-cube law is a reasonable and consistent description of the industrial organizational composition."

The present reanalysis began, as with the Haire data, by constructing scattergrams prior to introducing any statistical analysis. These graphs clearly suggest a constant ratio for all firms within each industry, with the exception of the aircraft and chemical groups, which show slight *increases* in the ratio E/I for the larger

[5] *Op. cit.*

Table 2. Levy–Donhowe data.

Industry	Mean ratio of employees in external and internal components	Mean size of firm
Drugs	.45	4,500
Food	.43	5,000
Metal fabrication	.29	4,000
Machinery	.23	7,000
Chemical	.19	8,000
Electrical	.18	7,000
Electronics	.13	9,000
Aircraft	.10	30,000

firms (20–70 thousand employees)—the direction opposite to the hypothesized change. In both the metal fabrication and machinery industries, the presence of a large sales-service oriented firm induces a best fit to a rising curve, but this tendency is clearly due to nonhomogeneity in the industrial samples.

A least-square regression equation was computed with the logarithmic transformation on the complete sample. Here the best fit was found to be $E = 0.1\ (I)^{0.81}$, compared to the hypothesized $E = I^{2/3}$. That the exponential is below 1.0 and close to the hypothesized value is an artifact of the sample selection.[6] Thus, in spite of their evaluation to the contrary *no evidence can be found in this cross-sectional selection of companies that will support the biological model.*

Levy and Donhowe's attempt to correlate various functional components such as research, administration, etc., with the internal-external ratio appears headed in a suggestive direction, though they are seriously hampered by retaining the odd-power transformation. Without referring to their full data, one can infer something about the internal makeup by establishing a simple rank ordering. With the assumption of a ratio independent of size, the (geometric) mean of the company ratios was computed and the companies ranked by that mean ratio, as shown in Table 2.

[6] The selection of companies in this study, produced a pairing of increasing total employment with decreasing external employees. This artifact of the study produces the *appearance* of a declining E/I ratio as a function of size for the total sample, in spite of the fact that each of the industries which makes up the sample has a near-constant or slightly rising ratio (see Table 2). Under such circumstances, testing for null hypothesis is meaningless.

There is a clear trend from the customer-oriented food and drug companies through the heavy manufacturing component of the fabricating firms, to the increasingly important research and developmental organizations in the electronic and aircraft industries.

The Draper and Strother Data

Draper and Strother[7] tested the various aspects of the Haire biological model by an analysis of the employment history of a single educational organization extending over 45 years. Besides examining Haire's analogies in a general way against the criteria of a good theory, they specifically examined the necessity of the square-cube law through a geometric exercise in which they compared the surface and volume of a great many archetypal solids. First they demonstrated that this square-cube relation is but a special case. Then they showed that for their data, a linear regression on the *raw* data produced nearly as good a fit as did a regression on the transformed data. With the location of a more parsimonious model of equally good fit, they concluded that the square-cube law of organizational growth is at best superfluous. With this the writer concurs, but neither on parsimony nor on the other criteria Draper and Strother invoke is the linear hypothesis much superior. It is but one of the amazing variety of models with two free parameters, which can be fit to a nearly linear array of observations.

The general exponential model used for reanalysis of the other data is another of the two-parameter models. In this case it provides a better fit than the linear or square-cube model. It is also a more reasonable model, as it does not suppose an organization with an interior but no exterior or the converse, as is implied by a non-zero intercept in the linear model. A comparison of fitting methods is given in Table 3.

Note that both the intercept and the slope assumptions are neglected in the cube-square fit, and the intercept assumption is neglected in the linear fit. If the assumption of the zero intercept had been recognized at least by adding a first observation at (0,0),

[7] *Op. cit.*

Table 3. Comparison of the three methods of fitting the data reported by Draper and Strother.

Method	Assumptions of model: Inter-cept	Slope	Power ratio	Estimating equation	r	Unex-plained variance
Square-cube	0	1	2/3	$E^{1/2} = 0.30 + 0.27(I)^{1/3}$	.99	790
Linear	0	—	1.0	$E = -26.65 + 0.51\, I$	.99	841
General—exponential	0	—	—	$E = 0.041(I)^{1.41}$	.99	697

the correlation coefficients would have been markedly reduced in the first two cases. As performed, the first two regression analyses cannot be interpreted as tests of their models.

Although the Draper-Strother article casts strong doubt on the specific model that Haire introduced, their devotion to the geometric and biological models seems almost to counterbalance the effect of their conclusion that *"the biological model does not seem to be valid* for describing or predicting the growth of organizations" (italics added). Had they concentrated on demonstrating the lack of a homological basis, there would be little need for further discussion of geometric-biological models in the organizational context.

Generalized Growth Models

The square-cube transformation applied to the internal-external data forces attention to one special case of the relation of the surface to volume. As Draper and Strother[8] illustrate, there is no *a priori* reason to suppose that organizations should usually have a form related to a special class of compact objects. They point out that the constant-growth ratio is a better representation of organizational geometry. And reanalysis of Haire's and Levy and Donhowe's data tend to support this tentative hypothesis. Yet the very concentration on the generalized geometric interpretation perpetuates a tradition that organizations can appropriately be described by archetypical objects in a three-dimensional space. In

[8] *Op. cit.*

this concentration, these and other social scientists display a Pythagorean devotion to numbers, diverting their attention from the underlying processes either in the biological world they choose for illustrations or in the organizational world they describe.

The usefulness of making analogies is that it does produce processed data highlighting regularities which may stimulate the search for more relevant models.[9] In this instance, one striking regularity that is displayed in the longitudinal studies is the fact that a given parameter or pair of parameters can so well represent the growth patterns in the individual firm for periods as long as 45 years. One is inclined first to look for an explanation in the method of data preparation and analysis. Had the observed values of the growth ratio c been collected more markedly about unity, one would suspect a high degree of error and randomness in the assignment of employees to the two components. Variation in the assignment of given jobs over the sampled years would cause a regression of c toward 1.0. The wide variety of estimated growth parameters and the sharply differing ratios of the sizes of the two components as expressed in the (linear) slopes, however, tend to rule out the conclusion that the constancy is an artifact of the analysis. On the assumption that the constancy is not an artifact, two alternative explanations of the data are proposed.

1. *Factors of Growth.* Each of the functions (job titles) which Haire allots to the interior or exterior component of an organization can be characterized by its own economy of scale. While the notion of economy of scale is traditionally applied to productive functions, it is equally meaningful for other performances in the organizations. The detailed proportionality is recognized in practice in the manning tables of the military and the organization of a team to open a new branch store, to drill a well, or to install a computer. The economy of scale of two major components can be defined as the sum of the weighted indexes of each of the functions, departments, and so on, subsumed under each component. Thus, the growth parameter c is the ratio

[9] One doubts, however, that "the data themselves will suggest the model" as Draper and Strother (*op. cit.*, p. 46) forecast.

$$\frac{dE}{dI}=\frac{\sum w_i \frac{de_i}{dN}}{\sum_j w_j \frac{di_j}{dN}}, \tag{4}$$

where de_i/dN and di_j/dN are the growth rates of specific identifiable departments as a function of the total employment in the firm, and w_i, w_j are weight coefficients dependent on the technology of the industry and its capital deployment. At some base point in the history of the firm, they could be interpreted simply as a proportionality $w_i = n_i/N$.

Through aggregation, small variations in the component ratios over time are absorbed so that the overall organizational ratio may very well be a constant or a systematically changing ratio such as appeared in the majority of the firms and as was suggested by the cross-sectional data. Thus we can in fact use the geometry—as a way of representing the algebraic equations, as a predictive tool—as long as the technology remains significantly unchanged. The parameter c is also associated with specific shapes, which in turn have come to be associated with the behavior of firms variously described as "production dominated," "sales dominated," or conforming to Parkinson's original law.

2. *Behavioral Regression.* Although one can expect a reasonable stability of the economy of scale functions in many parts of an organization, it is still surprising to find ratios as predictable as those that some of the sampled companies display. The relatively wide spread of values (of c) among the firms and within an industry suggests another "behavioral" source of stability. We can speculate that the stability arises from the backward-referenced planning conducted by the managers of the firms; that budgets for future growth are based largely on existing ratios and previous staffing decisions. In the absence of sufficient economic information for rational allocation of new budgetary employment, the least conflict-inducing method of distributing the new people is to maintain the existing ratios or the rate of change in those ratios. Change would be made in the allocation procedure only under extreme economic need or following the introduction of a significantly different technology.

And it may be that while the decision rules in current use are explicitly economic in theory, the ratios may be strongly conditioned by allocations and accounting conventions which can only be justified on traditional grounds. Thus, the two alternatives proposed may be behaviorally indistinguishable even though derived from quite different rationales.

Note that neither of these proposed alternatives to the biological model are either geometrically or biologically inspired, but are more nearly economic models. Furthermore, neither depends necessarily on dividing employees of the firm into an exterior and an interior component. *Any consistent classification scheme* would produce the same results: that is, a constant c and a constant b, though these parameters may take different values with each different classification pattern. The only link these explanations have with the geometric-biological world is through the common use of algebra as a mode of representation—hardly a sufficient base on which to claim anything approaching a homological identity.

CHAPIN'S FIBONACCI GROWTH MODEL

The frequency of making analogies without sufficient analysis of the underlying causal structure of the model and the process to be explained seems to increase with the number of isolated sets of data available to the social scientist and with his continuing adulation of the physical and biological sciences. A second (and earlier) example of this thinking in terms and analogies is provided by Chapin.[10] He attempted to find a rationale to associate some data[11] on the growth of a number of church congregations with their characteristics as viable and efficient organizations. His data consists primarily of *(1)* the sizes of the congregations in 1927 divided into the members *(M)* and those enrolled in the Sunday School *(SS)*—mutually exclusive subsets, *(2)* the age of the churches, and *(3)* a measure of their institutional strength.

In trying to understand the relation of the figure of merit to the pattern of growth, Chapin speculated that since the Sunday School provided the source of new members, a healthy church

[10] F. Stuart Chapin, The Optimum Size of Institutions: A Theory of the Large Group, *American Journal of Sociology*, 62 (March 1957), 449–460.

[11] Collected in Minneapolis by Wilbur C. Hallenbeck.

would have the proportion of current membership to its recruiting subgroup in appropriate balance. He noted a formal and analogical similarity between the relation of the two components and the generation of the Fibonacci series, which generates a logarithmic curve that has been noted as producing geometric patterns akin to the growth in many sea shells and in plants such as the sunflower. Assuming these growth patterns to be representative of a homeostatic equilibrium, he proposed that organization displaying such a growth pattern in its components would be a strong one. The Fibonacci series is most simply generated by summing the latest two terms to form the new term. It can also be generated by augmenting the most recent term by the larger of the two components of which it is the sum. These are equivalent generators, but the second is more suggestive of the process with which Chapin was concerned. A sample of the series as it is generated is $1 + 1 = 2$; $1 + 2 = 3$; $2 + 3 = 5$; $3 + 5 = 8$; $5 + 8 = 13$; .... From the series we can construct a ratio,

$$F = \frac{n_i}{n_{i-1} + n_{i-2}}$$

which rapidly converges as i increases to a value near 0.6180. If the organization is to grow according to this pattern, the components must be appropriately related, Chapin argued. He expected to find that healthy organizations would more closely approximate this proportion than those which were less strong. He chose therefore, to test the proposition that the organizational ratio, $F' = M$ $(M + SS)$, should be clustered around the value of F, and that the variations should be correlated with the figure of merit for each church.

For the 80 churches in Chapin's sample, the mean of the ratio F' is 0.5850. He noted also the strong correlation of the individual church ratios with the age of the church and the measure of institutional strength. His Table 2 is reproduced in part as Table 4.

From this data, Chapin concluded that "the optimum [shape] of a church may occur when [F' approaches F]. This optimum ratio is the cluster of social traits—which yields the maximum degree of continuity of security for group members by achieving a moving equilibrium (social homeostasis) among conflicting social influences and yet is consistent with the preservation of group bonds."[12]

The basis on which he argues for a fundamental relation between the Fibonacci series and the growth dynamics of the human organization leads one to look for a less tenuous explanation of the concentration of F' near the value 0.6180 and of the correlation of the F' ratio with the measure of institutional strength. A most appropriate place to look is the source from which the church draws its members; that is, the population at large, and specifically the family group. The Minneapolis census for 1930 shows that the mean family size was 3.78 persons, and that the ratio of adults (A) to children under 21 (C) in the total population was near 2:1. The analogous F ratio for the population would be $F'' = A/(A + C)$. Thus the societal value of F'' for the relevant population lies between 0.53 and 0.67 (depending on how one treats adults not included in family units), a range which includes the mean F' and about 30 of the 80 churches in the sample. Chapin's *central statistic* can thus be obtained from the simple assumption that *the church population is a representative sample of the city population* on at least this dichotomous age classification.

The covariance of the F' ratio with the age of the church can be accounted for by a commonplace explanation based on two premises, the validity of which has not been checked in this case: (1) The population in older districts of the city has a higher portion of adults than the newer districts; and (2) older churches are found in older districts. Or a proposition might be deduced from this pair: newly formed churches (say, up to 20 years old) have members of a lower median age than older churches. Either basis leads to the prediction that there would be more children (the SS component) in the younger churches and so to the prediction of the covariance of F' with age of the church. In turn, institutional strength appears to vary with the age of the churches utilized in the study (see Table 4). The general tendencies in the data are thus capable of being accounted for by simple

[12] *Op. cit.*, p. 457.

Table 4. Chapin's summary table.

Institutional strength rating	Mean age of churches	$F' = \frac{M}{M+SS}$	Deviation $F' - F$
Total	36.6	0.5850	−0.0330
A (highest)	47.5	0.6580	+0.0400
B + C	33.6	0.5566	−0.0614
D	18.0	0.5187	−0.0993
By age			
Very old ($n = 8$)	75.3	0.6688	+0.0508
Very young ($n = 8$)	10.2	0.4056	−0.2124

population statistics. The normative property is reduced to the proposition that a "best" church is one which has a representative sample of age distribution in the congregation.

Here again as in the case of Haire's proposition, there is a far simpler explanation than the biologically inspired geometric model. The two models discussed in this article appear to have a common weakness: in both cases, the biological analogy is superficially established. In the first case, it was based on a loose literary simile and permitted to persist by inappropriate analysis of data; in the second, a coincidence of two numerical values permitted a suggestive parallelism to be taken as a condition for organizational optimality. In spite of the fact that the explanations are belabored, there is some value in presenting these models if the data are presented in a form that others can also work with them. But this potential value can be heavily outweighed by the damage that can be caused by unskeptical acceptance. Haire's model is rapidly becoming part of the folklore of management theory, and now that it is embedded in textbooks as an empirical fact, it will take many years before the reverberations die down.

The use of analogies as an aid to constructing theories and models of social behavior has often proved fruitful; their very attractiveness makes it all the more important that care be used in their construction. The power of the imagery called up in such analogies as Social Darwinism goes well beyond the two examples given above, but it serves as a good example of how substantial normative force can be developed out of the biological analogies.

THE GEOMETRIC ANALOGY

In the main, this paper is an attempt to weaken the hold that models such as Haire's and Chapin's have apparently gained on the imagination of the students of organizations. This effort was aimed at the empirical basis supporting the plausibility of the models. A more general attempt is also needed to expose the groundlessness of analogies which depend on Euclidean geometry. Such an exposure would not, however, discredit the verbal similes associating spatial properties with groups and organization. It is generally understood, even if in a rather loose fashion, what is meant by a *compact* group, a person on the *fringe*, the *pyramid* of the organization, and so forth, but the Euclidean analogy can be put away with greater confidence if such loose analogies can be reestablished with another geometry more appropriate to the organizational world.

In order to maintain the existence of meaningful analogies of organization to geometric shapes, a set of basic equivalences would have to be established. Those requisite are organizational equivalences to the *elements*, the *relations* among the elemental objects, and a *metric* to establish *shape*. If each could be established, it would be possible to invoke some of the propositions and theorems of geometry, and some from the physical and biological sciences as well. It is rather easy to propose various suggestive equivalences for elements and relations; the failure of the many analogies that have been tried lies in the inability to establish a suitable metric for the organizational space; the continued failure leads to the conclusion that if we are to obtain any approximation to a useful geometry, some non-Euclidean device should be introduced. One approach would be to substitute for the geometric point a distribution of possible locations representing the places at which a member might be located at a particular moment. Such looseness might not be tolerable for a high-school geometry, but might be a rather useful construct in an organization theory. A second basis might be obtained by considering a human organization as converging through gradual adjustment toward a geometric Euclidean structure. Any actual organization operating in an unsettled environment with a continually changing set of employee members should not be expected to crystallize into a Euclidean solid.

A third variation on the geometric theme, based on the concept of individuals fulfilling roles in organizations, is one in which a complete fit to a geometric structure is obtained by introducing curved spaces which could be "deformed" to provide acceptance of a new role into the set of roles making up the extant organization. Deformation of the space could be seen as being caused by social, economic, and institutional forces. The introduction of shapes in curved spaces eliminates the possibility of translation and rotation essential to Euclidean geometry. Yet this aspect, inappropriate for the geometric analogy, fits common sense well; clearly an organization cannot be rotated or translated in a social space and be expected to retain its shape. Socialists and social reformers alike have run hard against this blunt fact.

Such analogies may provide some ideas on which a geometry of organizations might be constructed, but it is not at all certain that any of them would have value beyond serving as generators of ideas for the organizational theorists. The essential connection to the empirical world, an operational metric, is still missing. Possibly an economics of information will eventually provide an appropriate metric and the operations by which to establish empirical connections. If such a task is accomplished, geometry can enrich the science of administration as it has in the past aided mathematics, astronomy, physics, zoology, and other fields.