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THE LAW OF REQUISITE HIERARCHY

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A cybernetic theory of hierarchical social systems is given, starting from an extension of Ashby's general theory of regulation and control to amplifying regulation. Regulation and control in human society are then discussed and the conditions for the existence of social classes and social hierarchy examined.

1 BASIC NOTIONS OF THE GENERAL THEORY OF REGULATION

a Variety and Dependence

If A is a variable of any kind, the entropy $H(A)$ is a measure of its variety. It shows how much the various appearances of A differ from each other, whatever be the kind and nature of these appearances. For a quantifiable variable, entropy is just another measure of variance. But entropy can be used, as a measure of variety, for qualitative variables as well.

If A and B are two variables, the degree of their mutual dependence is measured by the entropy difference

$$H(A) - H_B(A) = H(B) - H_A(B) = I(A,B) \quad \text{(identity).} \tag{1}$$

One can check the identity, for instance, by substitutions

$$\begin{cases} H(A) = \sum_i p_i \log (1/p_i) \qquad \text{and} \\ H_B(A) = \sum_j p_j \sum_i p_j(i) \log [1/p_j(i)] \end{cases} \tag{2}$$

that hold good for finite sets A and B. Here p_i is the probability of the appearance i of A, and $p_j(i)$ the same probability under the condition that B has the appearance j.

If $I(A,B)$ is zero or, what is the same, $H(A) = H_B(A)$ and $H(B) = H_A(B)$, variables A and B are entirely independent of each other. If the conditional entropy $H_B(A)$, i.e. the average entropy of A for constant values of B, is zero, then the variable A is a function of the variable B:

$$H_B(A) = 0 \Leftrightarrow A = f(B). \tag{3}$$

If $H_A(B)$ too is zero, the function f is one-to-one. In this case the mutual dependence of A and B is maximal, their appearances fix each other and their entropies are equal. The remaining cases lie between the two extremes of complete independence and functional relationship.

The values of cybernetic entropy considered here are always positive or zero. A zero variety $H(A)$ means that all the appearances of A are identical. A zero-conditional variety $H_B(A)$ states that for a constant B all the appearances of A are the same.

b Ashby's Theory of Regulation

In the general case, the chain of effects in a process of regulation is the following:

$$D \rightarrow R \rightarrow Y \leftrightarrow E.$$

Involved here is a variable of disturbance D, a regulator R having a variety $H(R)$ of different regulatory mechanisms, an outcome variable Y, and the essential variable E of the system (R,E), having a region of survival E_0. There is a one-to-one mapping between variables Y and E, so that $H(Y)$ is equal to $H(E)$. The effect of the regulator is to make the difference $H(D) - H(R) = H(Y)$ smaller or equal to the upper limit $H(E_0)$, in order to guarantee the survival of the system.

To get at the most general formulation of Ashby's theory of regulation[3] we can first write down the two identities that connect the regulatory variable R with D and with Y:

$$\begin{cases} H(D) = H_R(D) + I(D,R), \\ H(Y) = H_R(Y) + I(Y, R). \end{cases} \tag{4}$$

The equations are valid whatever the variables D, R, and Y, so that there is no message about regulation in them. The first piece of information about regulation will be involved in our first assumption: we shall assume that for a passive regulator R all the variety of disturbance goes through unhampered into the outcome Y, apart from a possible constant reduction K:

$$H_R(Y) = H_R(D) - K \quad \text{(assumption 1).} \tag{5}$$

The term K can be explained as follows. Even if a tortoise does nothing to defend itself, there is the shell that gives it some shelter and reduces the variety of disturbances into the single dimension marked by "blows against the shell". A similar kind of constant shelter is offered by the skin of animals and by a building inside which the system (R,E) is located. By assumption 1 the outcome of regulation will have the variety

$$\begin{aligned} H(Y) &= H_R(D) - K + I(Y,R) \\ &= H(D) - I(D,R) - K + I(Y,R). \end{aligned} \tag{6}$$

This is the first relation between $H(D)$ and $H(Y)$ we have in a general regulatory process.

Next we shall assume that of the two dependencies involved in Eq. (6) only the dependence $I(D,R)$ matters in regulation. The other one, viz. $I(Y,R)$ or, what is the same, $I(E,R)$, can be interpreted as a casual term that may vary from time to time irregularly even within one and the same system (R,E). It expresses how much the regulatory part R and the essential variable part E of the system (R,E) disturb each other *beyond* the proper acts of regulation. There may be such mutual dependence of R and E outside of regulation, and the smaller it is the better the regulation. However, we shall consider it as a casual positive term that can be eliminated from further discussion:

$$I(Y,R) = I(E,R) \text{ is a casual term (assumption 2).} \tag{7}$$

Assumption 2 together with the substitution of $H(R) - H_D(R)$ for $I(D,R)$ gives the final shape of Ashby's Law of Requisite Variety:

$$H(Y) \geqslant H(D) + H_D(R) - H(R) - K. \tag{8}$$

It tells that for a given disturbance D we can reduce the effect of disturbance on the essential variable E

i) by a constant shelter K due to some constant covering (a tortoise shell, skin, building etc.), and

ii) by the variety $H(R)$ of regulatory acts, while the effectivity of these efforts is reduced

iii) by the uncertainty $H_D(R)$ involved in the acts of the regulator.

The uncertainty expressed by the conditional entropy $H_D(R)$ represents the ignorance of the regulator about how to react correctly to each appearance of a disturbance D. Only a regulator that knows how to use available regulatory acts in an optimal way will reach the optimal result of regulation, which is

$$H_{\min}(Y) = H(D) - H(R) - K. \tag{9}$$

In the general case the result of regulation, assuming $I(E,R) = 0$, will be

$$H(Y) = H(D) - H_{\text{eff}}(R) - K, \tag{10}$$

where the *effective regulatory ability*

$$H_{\text{eff}}(R) = H(R) - H_D(R) \quad \text{(Def.)} \tag{11}$$

now appears.

A necessary condition of survival is expressed by the requirement that the variety of outcome be smaller than or equal to the variety of the region of survival E_0:

$$H(Y) \leqslant H(E_0). \tag{12}$$

c The Principle of Variable Structure

A prototype of a self-regulatory system (R,E) is the homeostat built by Ashby.[2,3] The positions of the four needles in Ashby's homeostat constitute the essential variable E. The regulatory variety $H(R)$ is that of the 25^4 different and mutually alternative resistances coupled to the net. The variety of disturbance $H(D)$ is given by the various possible original deviations of needles from their zero positions. There is no constant shelter in the homeostat so that $K = 0$. The acts of regulator are perfectly controlled in the homeostat so that the uncertainty $H_D(R)$ also is zero. In fact, the successive couplings of different resistances follow each other according to a prescribed scheme so that, when necessary, the whole variety $H(R)$ can be utilized for each single appearance of disturbances. Thus the Law of Requisite Variety in the case of the homeostat reads:

$$H(E) \geqslant H(D) - H(R). \tag{13}$$

The theoretical minimum $H(D) - H(R)$ is truly attainable, as the mutual dependence $I(E,R)$ is zero in the homeostat; the switching device that takes care of the couplings and recouplings of resistances is entirely independent of the positions of the needles E *in between* the various acts of regulation. (For a constant resistance, and thus for a constant R, the positions of the needles E vary continuously along a path on the hyperplane corresponding to that particular value of R; switching on of a new resistance changes the value of R, and accordingly the hyperplane on which the gradual change of needle positions occur.)

The variety of disturbance $H(D)$ is destroyed in the homeostat by the variety of structure $H(R)$ or, what is the same, by the capability of self-organization of the homeostat. Thus a structural condition of the Law of Requisite Variety is the variability of the structure of the self-regulatory system (R,E). We can speak of a Principle of Variable Structure, an instance of which is the homeostat; a high-level regulation implies variable structure in regulator, so that the ability of self-organization becomes an essential feature of high regulatory performance.

Another example of variable structure, in fact, the basic example that the homeostat was constructed to imitate, is the human brain. The essential variable, in terms of which the survival of living organism is expressed, indicates how inner organs and glands are functioning, the respiratory system and the circulation of blood there included. Thus, in this case we have: R = brain, E = functioning of inner organs and glands. The unconditioned reflexes that automatically restore balance in inner organs in the case of minor disturbances are ordinary servomechanisms. They have a rigid structure that is incapable of self-organization. The latter property and thus the higher regulation belongs to the higher parts of the brain, especially to the cortex.

Human or animal organism, considered as self-regulator, does have a constant shelter $K > 0$ given by the skin. On the other hand, there is some mutual disturbance between the parts R and E of the system, i.e. between the normal functioning of inner organs and the brain. This manifests itself as a disturbance of inner organs due to nervous diseases, of heart nerves for instance. Another manifestation of a non-zero term $I(R,E)$ are the disturbances of the nervous system due to some malfunction of the organs.

In the case of the brain system (R,E) there is a positive term $H_D(R)$ that expresses the ignorance of man, or of an animal, as to how to react to each disturbance. The gradual reduction of this ignorance is in psychology called adaptation. At the beginning of each process of adaptation the ignorance is large, and it converges toward zero with a successful adaptation:

$$H_D(R) \to 0 \quad \text{(a successful adaptation).} \qquad (14)$$

Structurally adaptation is a process of self-organization similar to that occurring in the homeostat of Ashby. The great variability of structure so characteristic to the human brain is essential for successful adaptation. The human brain has the greatest known structural entropy $H(R)$, and accordingly it is the best example of both the Principle of Variable Structure and the Law of Requisite Hierarchy. Both the Principle and the Law are inherent in Ashby's thinking, though Ashby did not name the Principle (the name used here was suggested by the present writer).[4]

2 THE EXTENSION OF GENERAL THEORY TO AMPLIFYING REGULATION

a A Hierarchy of Regulation and Control

Let us suppose that a regulator $R^{(1)}$ is incapable of reducing the variety of original disturbance $H(D)$ to the required level of survival, $H(E_0)$. The situation may be saved, if we have another regulator $R^{(2)}$ that can be put to regulate further the outcome Y_1 of the first regulator. Then the optimal result of the first regulation,

$$H(Y_1) = H(D) - H(R^{(1)}) \qquad (15)$$

reduces in the optimal case further to

$$H(Y_2) = H(D) - H(R^{(1)}) - H(R^{(2)}). \qquad (16)$$

This may be still insufficient. But then, if we have a third regulator to handle the outcome Y_2 we can proceed and go on until a regulator of order m will yield a satisfactory result. The final outcome of regulation will then be

$$H(Y) = H(D) - H(R^{(1)}) - H(R^{(2)}) - \ldots - H(R^{(m)}) = H(D) - H(R). \qquad (17)$$

Now the sequel of m regulators together makes up a regulator R whose optimal regulatory ability is the sum of those of its parts:

$$H(R) = H(R^{(1)}) + H(R^{(2)}) + \ldots + H(R^{(m)}). \qquad (18)$$

In the general case, however, the optimal result in Eq. (17) is not achieved because of the existence of the uncertainty term $\dot{H}_D(R)$ in the effective regulatory ability in Eq. (11). If nothing can be done with it, there will be in the sequel of m regulators a total uncertainty that amounts to (see Figure 1)

$$H_D{}^0(R) = H_D(R^{(1)}) + H_{y_1}(R^{(2)}) + \ldots + H_{y_{m-1}}(R^{(m)}). \tag{19}$$

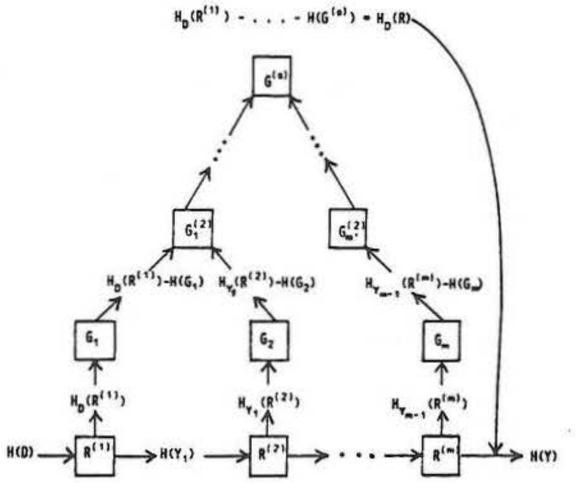

FIGURE 1 A hierarchy of regulation and control.

But this, in turn, can be reduced by arranging to each regulator a controller, or a "governor" G_l specializing in the reduction of uncertainty that is inherent in the regulatory acts of $R^{(l)}$. If this is successful, the uncertainty of $R^{(l)}$ may be reduced by some positive amount $H(G_l)$ to yield the result

$$H_{y_{l-1}}(R^{(l)}) - H(G_l) \quad \text{(effect of governor } G_l). \tag{20}$$

As a total effect of all the m "first-order governors" $G_1, G_2, \ldots, G_m$ the original uncertainty of our m regulators will be reduced by the amount

$$H(G^{(1)}) = H(G_1) + H(G_2 1) + \ldots + H(G_m). \tag{21}$$

The remaining uncertainty, after the work of first-order governors, will be equal to

$$H_D{}^0(R) - H(G^{(1)}). \tag{22}$$

We can, of course, go on and build a hierarchy of control as well until we reach the top governor $G^{(s)}$, the total effect of the wisdom of all governors being

$$H(G) = H(G^{(1)}) + H(G^{(2)}) + \ldots + H(G^{(s)}). \tag{23}$$

The remaining final ignorance will be

$$H_D(R) = H_D{}^0(R) - H(G). \tag{24}$$

The hierarchy of regulation and control that was built to reach this end is shown in Figure 1. An earlier example of such a hierarchy was given in my previous paper.[4]

b The Law of Requisite Hierarchy

Neglecting the trivial constant K and taking the optimal case $I(R,E)$, in which the regulatory and the essential variable mechanisms do not disturb each other, the result of regulation obtained through the hierarchy in Figure 1 will be

$$H(Y) = H(D) - H_{\text{eff}}(R), \tag{25}$$

where

$$H_{\text{eff}}(R) = H(R) - H_D{}^0(R) + H(G). \tag{26}$$

Depending on the magnitude of the *control entropy* $H(G)$ the effective regulatory ability $H_{\text{eff}}(R)$ will lie somewhere between a minimum and a maximum:

$$H(R) \geqslant H_{\text{eff}}(R) \geqslant H(R) - H_D{}^0(R). \tag{27}$$

As expressed by formulae (26) and (27) and illustrated in Figure 1, the magnitude of the effective regulatory ability depends on the organization of regulation and control in the system concerned, the effect of organizution on entropy being equal to $H(G)$. An essential result from our theory can be put into words as follows:

The weaker in average are the regulatory abilities and the larger the uncertainties of available regulators, the more hierarchy is needed in the organization of regulation and control to attain the same result of regulation, if possible at all.

This is the Law of Requisite Hierarchy in its most general and least specified form.

The law tells, in accordance with Figure 1, that the lack of regulatory ability can be compensated for, up to a certain amount, by a greater hierarchy in organization. The upper limit beyond which no compensation can occur is given by the total ignorance $H_D{}^0(R)$ to be compensated for.

The content of the above law seems to have been published in English for the first time in an article of the present writer published in 1975 in Cybernetica,[1] though without the precision and generality offered by the notion of entropy as used above.

3 REGULATION AND CONTROL IN HUMAN SOCIETY

a Productive Forces as Regulator

To give an example of the application of the Law of Requisite Hierarchy, let us consider the regulation and control needed in human society—considered as a whole—for the survival of its population. For this end we have to define first the variables D, R, Y, and E we have in this case.

To begin with variable E, we know that the survival of man means, in physiological terms, the proper functioning of inner organs and glands. So the essential variable E of man, no doubt, records the functioning of those organs. As a disturbance *par excellence*, threatening to throw the essential variable off the region of survival E_0, there is the recurrent loss of energy that is felt as hunger. Diseases are another factor threatening man's existence. Further, potential disturbers of man's survival are all one's natural and human enemies—whether beasts, storms, cold, or hostile nations or tribes at war. All these and other factors threatening the survival of human community together constitute the variable of disturbance D.

To counteract all the various disturbances threatening its survival the human community can mobilize a strong regulator that no animal communities have, viz. organized social production. The machinery of regulation R is in human society composed of the production and distribution of goods and services (including the armed services needed at war). The remaining hunger, diseases, etc. that could not be eliminated by produced goods and services (services offered by weapons there included) make up the outcome Y of regulation. The variety of Y is then transferred to the essential variable E that measures the functioning of vital organs in the population. The survival of population, whatever its operational definition, finally boils down to keeping the values of the essential variable within the region of survival E_0. Hence the variables of the regulatory process in human society are those illustrated in Figure 2.

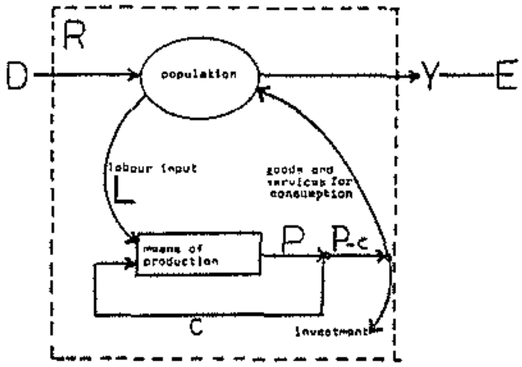

FIGURE 3 Productive forces as regulator.

As for the structure of regulator R we can at once give a somewhat more specified picture (see Figure 3). Production in human society is based on labour input L and means-of-production input c. If the output of production is denoted by P, part c of it is fed back into production to keep it going, while the rest $P - c$ is available for distribution. Some part of the latter is consumed by the population, which on the other hand produces the labour, and another part is possibly saved for investment, which means having a greater production at the next period of production. As labour together with the means of production are the "productive forces" keeping the whole process of production and distribution going, we can call the productive forces the essential part of regulator in human society.

b. The Labour Index of Productional Regulation

For a quantitative discussion we need a universal measure of productive forces, that is, a measure in terms of which to record the magnitudes of both the inputs and outputs of production. We could name such a measure "material value". Money, for instance, is a measure of material value. But for theoretical considerations we can use an even more general measure, which brings out the significance of human labour as the primary source of material value.

FIGURE 2 The variables of regulatory process in human society.

If q_i is the material value of one unit of product i, there being r different kinds of products produced corresponding to $i = 1, 2, \ldots, r$, we obviously must have:

$$q_i = l_i + \sum_k m_{ik} q_k. \quad (28)$$

Here l_i is the material value of labour needed in the production of one unit of i, and m_{ik} is the amount of product k (in terms of some physical unit like number of machines, or kilograms of material etc.) needed when producing one unit of i. In a matrix form we have

$$q = l + Mq \quad (29)$$

with the non-negative solution

$$q = l(1 - M)^{-1} = l + lM + lM^2 + \ldots \quad (30)$$

that holds good and converges provided that l and M are non-negative and the *eigenvalues* of M are in absolute values smaller than one (this can be taken to define a genuine process of production). By Eq. (30) the material value q of goods and services is reduced to the material value of labour, l. We can thus call q the labour index of material value (the idea of course is very old, and Marx and even Ricardo already had it). The structure of productive forces, at any given moment or period of the history of the given society, can be indicated by the combination of variables,

$$(l, M) = \text{structure of productive forces.} \quad (31)$$

This is apt to change with time, as education affects l and the progress of technology changes the "technical matrix" M.

Production takes time, and during a given period of production one can only produce a limited number of units of each product, the maximal number N_i of units of product i being determined by the length of the period as well as by the structure of the available productive forces. If everything runs well, that is, under a perfect organization of production and distribution, maximal numbers are reached. The corresponding maximal material values P and L of the total product and of the product available for distribution will then be

$$\begin{cases} P_{max} = \sum_i q_i N_i = qN \quad \text{and} \\ L_{max} = P_{max} - c = (q - qM)N = lN, \end{cases} \quad (32)$$

respectively. Here N is a column, while q and l are rows. Normally, with an imperfect organization, the maximal results are not necessarily reached but we have instead of Eq. (32)

$$\begin{cases} P \leqslant qN, \\ L \leqslant lN. \end{cases} \quad (33)$$

The role of productive forces as regulator can be defined by stating that there is a minimum consumption of goods and services, which is required for the survival of the population in each historical situation. Let the labour index of the total material value of minimum consumption be l_0. The limit l_0 is the minimum consumption that is needed for the reproduction of labour and thus for the continuation of the process of production. Its existence, obviously, is the labour equivalent of the difference of entropies $H(D) - H(E_0)$ that, at least, must be destroyed by regulation for the system to survive. To the maximal regulatory ability $H(R)$ there corresponds the maximal material value L_{max} of goods and services that are available at most for consumption, while the effective regulatory ability $H_{eff}(R)$ has its counterpart L. A necessary condition of survival then is

$$L_{max} > l_0, \quad (34)$$

which corresponds to the entropy requirement that $H(R)$ must be larger than $H(D) - H(E_0)$. So we get the mutual correspondence of the entropy and labour indices of regulation shown in Table I.

c The Law of Requisite Social Hierarchy

Let us now study the material surplus value

$$s = L - l_0 \quad (35)$$

that is produced over the minimum l_0 necessary for survival. Once there is a positive surplus one can

TABLE I

The mutual correspondence of the entropy and labour indices of regulation

	Entropy index	Labour index
Challenge to be met	$H(D) - H(E_0)$	l_0
Maximal regulatory ability	$H(R)$	L_{max}
Effective regulatory ability	$H_{eff}(R)$	L
Necessary condition of survival	$H(R) > H(D) - H(E_0)$	$L_{max} > l_0$

detach a part of population from the bulk of labour force and make of it the governing class needed for a control hierarchy. The existence of such a class was made possible by a positive surplus s, while the positive social function of a governing class is due to its possible ability to effect the necessary control in regulation, i.e. to push the truly attained effective regulatory ability nearer to its maximum $H(R)$, i.e. to push L nearer to L_{max}. If a part s_g of surplus is used for sustaining a governing class (and recorded, for instance, as expenditure to government, justice, and higher education), another part s_l is invested in labour (in form of better vocational and general education, better social policies, better salaries etc.), and a third part s_c is invested in the means of production, we have the combined regulation and control system $R + G$ illustrated in Figure 4.

We can go further by representing the system $R + G$ of Figure 4. in terms of the respective flows of entropy, which is done in Figure 5. The original uncertainty $H_D{}^0(R)$ of the regulator R is by the management of G reduced by a certain amount $H(G)$ of control entropy. The remaining uncertainty will be

$$H_D(R) = H_D{}^0(R) - H(G). \qquad (36)$$

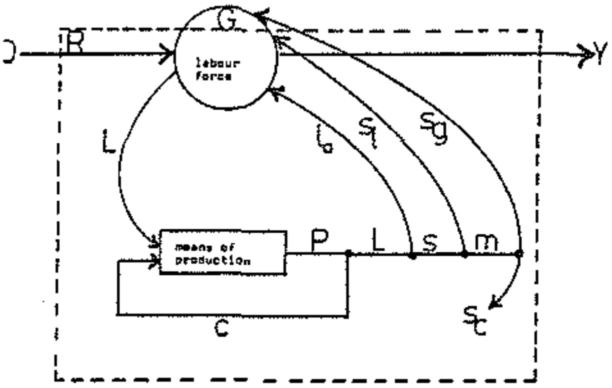

FIGURE 4 Production and distribution in a society producing a surplus value s.

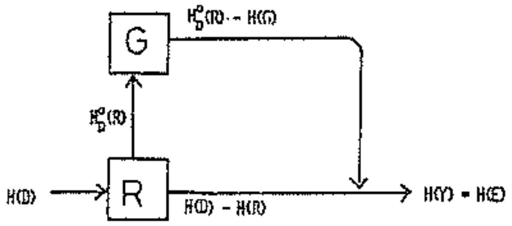

FIGURE 5 The entropy relations of regulation in a society having a governing class G.

The truly attained regulatory ability, after the improvement due to management, will be

$$\begin{aligned} H_{eff}(R) &= H(R) - H_D(R) \\ &= H(R) - H_D{}^0(R) + H(G). \qquad (37) \end{aligned}$$

The difference between the optimal regulation and the attained one is thus

$$H(R) - H_{eff}(R) = H_D{}^0(R) - H(G). \qquad (38)$$

Here the first term $H_D{}^0(R)$ states the magnitude of the lack of self-control in the regulator R that has to be removed by management, or control effected from outside. If a process of regulation, where the regulator itself controls its own action, is called self-regulation then the term $H_D{}^0(R)$ measures the lack of self-regulation in R. We must assume that the more primitive and undeveloped are the productive forces of society the farther they are from self-regulation. Then a large $H_D{}^0(R)$ is a characteristic of primitive, undeveloped productive forces.

But the larger is $H_D{}^0(R)$ the more control of production and distribution must occur from outside, in the form of the control entropy $H(G)$, if an effective regulation is wanted. But a large control entropy $H(G)$ means a strict social hierarchy in the social system $R + G$. So we come to the conclusion that the more primitive and undeveloped are the productive forces of society the stricter social hierarchy is needed for efficient regulation, and thus for the survival of the community. To be precise: the larger the lack of self-regulation of productive forces, as measured by uncertainty $H_D{}^0(R)$, the more can be gained by increasing the social hierarchy as measured by control entropy $H(G)$.

On the other hand, with developing productive forces they become, no doubt, better self-regulating so that the total gain obtainable by a social hierarchy decreases. If technological processes and automation in particular finally make the productive forces approach full self-regulation, there will be no excuse any more for any social hierarchy, including the existence of social classes. Summing up we have the following result:

Requisite Social Hierarchy In a society with a given structure of productive forces, indicated in entropy terms by their optimal regulatory ability $H(R)$ and by their lack of self-regulation $H_D{}^0(R)$, the effective regulatory ability $H_{eff}(R)$ can be improved by increasing hierarchy in the social organization of production and distribution, indicated by increasing control entropy $H(G)$, until the optimal regulation

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allowed by the level of productive forces $H(R)$ is reached:

$$H_{\text{eff}}(R) \to H(R) \quad \text{with} \quad H_D{}^0(R) - H(G) \to 0; \qquad (39)$$

after this all further growth in hierarchy is unnecessary. With increasing self-regulation of productive forces the gain obtainable by social hierarchy decreases until it entirely disappears when the productive forces approach full self-regulation, i.e. when

$$H_D{}^0(R) \to 0 \quad \text{(growth of self-regulation)}, \qquad (40)$$

in which case all useful class boundaries between people in production R and people in the governing class G lose their significance.

We can at once record two corollaries of this law:

Corollary 1. Existence of Social Classes Social classes in the fundamental sense based on the control of production and distribution must be considered to exist as soon as any means of control—whether economic ownership or political, administrative, juridical or other power—distinguishes a group of people G who are permanently, in the society in question, functioning as controllers G_K of production and distribution; this state of affairs distinguishes the governing class G from people working in the production and distribution as parts of the regulator R itself.

Corollary 2. Possibility of Classless Society In view of the Law of Requisite Social Hierarchy, social hierarchy including the class differences can be eliminated with the progress of productive forces without risking the survival of human community; however, the pace at which this kind of human emancipation can be realized is strictly determined by the advancement of productive forces, allowing no "leap" straight into a classless society but only gradual, relative steps.

The Law of Requisite Social Hierarchy and Corollary 1 yield in particular, a theoretical basis for the understanding of both the "capitalist" and the "bureaucratic" leading classes. But the Law and its Corollary 2 also entail the "progressive" idea of human emancipation, though they are apt to warn of the danger of unrealistic hopes: relaxing too much hierarchy at one stroke may lead to the establishment of compensative hierarchy in some other form—from strict capitalism to strict bureaucracy for instance—as the requisite hierarchy must be somehow produced to safeguard the survival of community.

d Note on the Units of Regulation and Control in Human Society

In Figure 5 we have a representation of hierarchical society but only a rough outline of its two main classes R and G. In Figure 1 a more detailed picture of a hierarchy of regulation and control was depicted, though without the interpretation of units in terms of human society. The successive steps of regulation $R^{(1)}, R^{(2)}, \ldots, R^{(m)}$ correspond to the successive steps of production and distribution in human society, beginning with the production of labour in households followed by the preparation of goods and services in successive steps, and ending up with their distribution that also entails successive steps. However, more useful as units of productional regulation are the institutions $R_1, R_2, \ldots, R_n$ where the work is done: households, productive and service institutions, points of distribution. Each step $R^{(i)}$ usually involves several institutions, as illustrated in Figure 6.

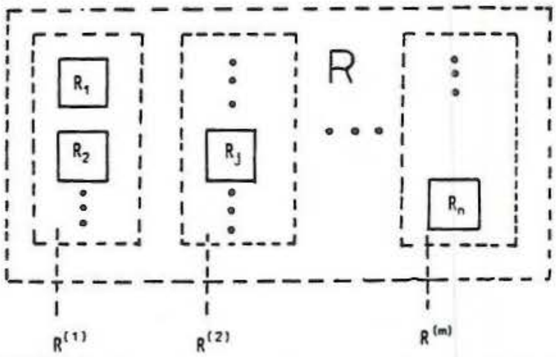

FIGURE 6 From the successive steps $R^{(i)}$ to the units of regulation R_j

As for the interpretation of control units G_k we can—just like in the case of regulatory units R_j—make use of larger or smaller institutions, depending on the problem discussed. For instance, if you are studying the management in an enterprise, you have, of course, to deal with different kinds of control units from those existing at a "macrosocial" level. In this paper the focus was on the hierarchical structure of society as a whole. Therefore, the internal structure of G was ignored.

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