exceptionally plastic behavior. His social environment is determined culturally in large part and not purely biologically as in other animal "societies."[4] In meeting his needs, man acts upon nature with tools he designs and produces, and his activity constantly expands his ability to adapt himself to the environment and the environment to him. As his technology develops, his social relations and behavior undergo change. It is the continuous interplay between biological and cultural influences which determines an individual's personality and behavior.

Gerard and Emerson's verbal equation of the "direction" of organic evolution and the "plan" of a lion stalking his prey with what I called "planned activity of men" ignores the unique prevision involved in man's planning. Whatever the lion's intent, it is not the reasoned plan of the framers of a Constitution. The influence of the lion's behavior on evolution is not the issue; did the lion plan this influence?

Philosophers have long shown the fallacy of arguing that because there is apparent design in animate nature, an intelligent designer exists. Conversely, the lack of design or visible plan in human history may not legitimately be taken to mean the absence of underlying intelligent planning by men. The behavior of the individuals who collectively make history is purposeful, planned behavior. The outcome of this planned activity may not often resemble the initial plans because every social event involves the interactions of many individuals and groups with actions beyond the control, and often the prediction, of the individual.

Recent developments indicate that social outcome will tend to resemble plans more closely than it has in the past. Society's control over nature, as shown by its productive capacity, is increasing. Social science is steadily growing in maturity. Planning is becoming a cooperative process in which increasing numbers of men participate. As these prospects for valid and effective planning are realized, there will be a fuller utilization of the peculiarly human ability to substitute consciously directed forces for blind unconscious forces such as operate in biological evolution.

Gerard and Emerson contend that natural selection operates at both biological and sociological levels. As generally understood, natural selection involves selective action on genotypes, with the non-perpetuation of those producing unfavorable reactions to the environment. It undoubtedly played a decisive part in man's evolution and his attainment of the position of dominance in nature. In the process, the survival value of man's group relations was probably very significant. But changes occurring in human group relations as society developed have been due to cultural-social causes and not to biological change. They have been much too rapid to be dependent upon natural selection. While in the last several centuries there has been much social change, natural selection has caused little, if any, correlated change in man's genotypes. Social survival value, both on an individual and population level, has not corresponded with biological survival value.

Gerard and Emerson's failure to give due importance to the qualitative differences between the biological and sociological levels is also apparent when they: (1) remove the well-established connotations of the word "purpose" and make it a synonym for "function" or "adaptive significance"[5]; (2) make the word "cooperation" so broad as to lose all specific meaning and then use the extent of "cooperation" between parts and whole as the criterion of both biological and social progress; (3) use the facts of convergent evolution within the biological level to support Gerard's far-fetched analogies between biological and social processes; (4) object to my attempt to narrow the meaning of the word "social" or "sociological" so as to distinguish between human societies and those of other animals[6]; and (5) describe both organisms and societies as "living systems" and use the term "autocatalysis" for such dissimilar processes as gene duplication and learning.

To-day, when the fact of evolution is generally accepted, underemphasis of the discontinuity of the levels through which matter develops may impede our understanding perhaps as much as did the denial of continuity a century ago.

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[4] *Cf.* Lawrence K. Frank, *Scientific Monthly*, 56: 344–357, 1943; and Bernhard J. Stern, *Social Forces*, 8: 264–271, 1929.

[5] *Cf.* R. M. MacIver, "Social Causation," pp. 13–24. Boston, 1942.

[6] For the need for such distinction see W. M. Wheeler in "Human Biology and Racial Welfare," ed. E. V. Cowdry, p. 141, p. 150. New York, 1930: David Katz, "Animals and Men," p. 250. London, 1937; Lawrence K. Frank, *op. cit.*; R. M. MacIver, *op. cit.*

TOXICITY OF NEMATODE INFESTED CHEWINGS FESCUE SEED

DURING the winter of 1943–44 it was observed by the Department of Veterinary Medicine of the Oregon State College that losses occurred among sheep consuming a certain lot of 1943 Chewings fescue (*Festuca rubra, commutata*) screenings. Some of the implicated material was obtained by the author during the following summer, stored at room temperature, and used since then for the experiments referred

to below. The screenings were essentially free from noxious weed seeds and from ergot sclerotia.

Experiments were initiated to determine the suitability of rats as a means of tracing the causative agent. It was definitely established in July, 1944, that the material in question contained something which is highly toxic to rats. Sixty parts of normal stock ration mixed with forty parts of powdered screenings killed rats in an average of about ten days. Subsequent experiments have involved a study of the symptoms produced at different levels of intake and a search for the causative factor.

The symptoms observed varied with individual animals and with the level at which the toxic material was fed. Frequently observed symptoms in rats were:

(1) Incoordination to complete paralysis of rear quarters.

(2) Extreme swelling and discoloration (dark red) of usually one rear leg only, frequently followed by sloughing of affected tissues.

(3) Dark blue discoloration of tails, frequently followed by tail eating.

(4) Extensive tissue hemorrhages.

Preliminary experiments with 2-week-old chicks indicate that they are even more sensitive to the toxic material than are rats.

No decrease in toxicity has been observed in screenings stored at room temperature since July, 1944. The toxic factor is largely insoluble in ethyl ether and in petroleum ether but is largely, if not entirely contained in boiling alcohol extracts. Results obtained to date with several lots of screenings fed to over 150 rats, strongly suggest a causal relationship between toxicity and the degree of nematode (*Anguina agrostis*) infestation of the fescue seed.

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SIGNIFICANCE OF NEGATIVE RESULTS IN SMALL SAMPLES

AT the recent Gibson Island Conference on Cancer, reports were made on the failure to cause regression of tumors by the use of various chemotherapeutic agents. It was stated that from 10 to 25 animals were used in each experiment. The question was raised whether such numbers were always adequate to test therapeutic effect, particularly since, in cancer, true effectiveness of as little as 10 per cent. may have practical importance. The reply made was that the types of tumor employed never regress spontaneously and consequently regression in even one animal would be highly significant. During the discussion it appeared that other investigators were following this line of reasoning. It seems desirable, therefore, to point out that while a single positive result in a small group of animals bearing tumors which do not regress spontaneously would be significant, in the sense that it would lead to further testing, the converse is not true, *i.e.*, failure to observe a single regression in 10 to 25 animals does not always conclusively demonstrate the absence of therapeutic power. If a therapy were capable of causing 10 per cent. regressions, then, in samples of 25 animals, no regressions might be observed by chance in $.90^{25}$ or 7 out of a hundred trials. One may question whether a possibility as important as effective cancer therapy should be dismissed with so high a margin of error.

Following the convention of considering a chance probability of over .05 as too great to be reliable, Table 1 states the various sizes of sample (n) for which the probability of no successes would be .05, for various values of true effectiveness (p).

TABLE 1

PROBABILITY OF NO SUCCESSES = .05 = $(1-p)^n$ FOR VARIOUS VALUES OF p AND n

p	.10	.15	.20	.25	.30	.35	.40	.45	.50
n (to nearest whole number)	28	18	13	10	8	7	6	5	4

In experiments with groups of 10 animals one might easily miss chemotherapeutic agents which had an effectiveness of less than 25 per cent. This is, of course, elementary probability, but it is of interest that in this instance the considerations of elementary probability may have been ignored because of failure to distinguish between the significance of a single positive result not noted before and the significance of the absence of this result. The crucial experiment when successful may be conclusive, but, if it is unsuccessful, one must still ask whether the experiment as performed allowed the positive event sufficient opportunity to occur. Since we are about to witness great activity in the field of experimental chemotherapy of cancer, it is to be hoped that none of this work will be rendered inconclusive on such well-recognized grounds.

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THE RUMBLING OF THUNDER

THE rumbling of thunder certainly does not arise from any single cause. Among possible causes Humphreys[1] lists (*a*) inequalities in the distance from the

[1] W. J. Humphreys, "Physics of the Air," McGraw-Hill, ed. 3, pp. 379, 441. 1940.