1890, 228 from 1890 to 1899, 273 from 1900 to 1909, 457 (31 percent) from 1910 to 1919, and 418 (29 percent) from 1920 to 1929. Some declined to list a birth date.

Only 153 are not listed in *American Men of Science* (Physical Sciences volume). Of those who are married (at least 77 percent), 46 percent married between ages 25 and 29, inclusive, and 28 percent between 20 and 24. Only two persons were married before the age of 20, and only 20 listed more than one marriage. The total number of children is 2100, an average of 1.9 per faculty marriage.

Approximately 20 percent reported full-time industrial employment as part of their experience. However, for the purposes of this survey, employment by government agencies, as well as wartime work at Oak Ridge and similar installations, was not counted as industrial experience.

One may reasonably conclude from the foregoing data that university chemists are social and occupational conservatives.

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19 July 1955

Hazards of Biological-Social Analogy

I suppose that H. W. Stunkard may have been teasing, or at least writing with his tongue in cheek, when he contributed "Freedom, bondage, and the welfare state" [*Science* **121**, 811 (1955)]. I can hardly believe that he intends to argue that, at present, we live in the most perfect of all imaginable human societies, and that any further cooperative action to assist our fellow-citizens must necessarily lead us downhill to biological degeneration. I hope that Stunkard will agree that much of the social progress that is now generally accepted as beneficial (universal suffrage, child labor laws, and so forth) was once considered very controversial and dangerous, if not actually contrary to nature.

Of course, Stunkard has the right to hold fast to his own opinions regarding the value of various forms of animal life, even when these opinions appear to have originated from his reaction to situations in human society. However, it is possible to come close to logical sophistry in this way.

To take just one example, it seems a shame to have Stunkard declare that the honeybee is *in reality* ". . . a most pathetic little creature . . . a martyr, and [a] victim of the 'welfare state'." As a person who has had some slight contact with bees, I would like to offer the dissenting opinion that the bee's world appears to be very full, satisfying, and creative, at least from the point of view of the bees. They certainly resent interference. The moral is this: If I hope to establish any sort of meaningful relationship with the bees (and occasionally share in their honey), I must, in some degree, be willing to accept the bees as they are and to cooperate with them in their own way of life. Would it be more patriotic for me to boycott the bees until they agree to accept the principle of universal suffrage and to choose their queen every 4 years in a general election?

I sincerely hope that Stunkard's paper will not be used to give quasi-philosophic support to an idea that has already become one of the chief plagues of our times. This is the idea that we cannot live securely in our American society until we have managed to recreate the entire world in our own image.

In conclusion, I think that we are merely deceiving ourselves, and other people as well, when we take hold of any special political and social philosophies (no matter how worthy), dunk these ideas in the sacred waters of some scientific specialty that has been developed to explain and interpret entirely different phenomena, and then fish them out and bring them back to where they originated in the first place, but now representing them as part of the *cosmic scientific secret of the universe.*

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23 June 1955

I cannot agree that Stunkard's conclusions follow from the facts and discussion that he presented. After a considerable array of descriptive information and theoretical deduction about the probable phylogeny of the animal phyla, he stated that "The welfare state offers security to workers on terms of contingent subjection and dependency, but such a social order reduces the individual to abject subservience, and results in the development of a rigid caste system. Dependency and degeneration are cognate phenomena, they go hand in hand. . . ."

Although analogy may be both inspiring and educational, we must recognize the limitations of such illustration. Theory may be contrived, but conclusions, especially those about ethics and morals, should have some relationship to reality. Stunkard's analogy between biological dependency and degeneration on the one hand, and dependency between men, and degeneration of men, in human society on the other, does not warrant the conclusion quoted in the preceding paragraph.

Human beings, by their very nature, must be as dependent as, if not more so than, many other animals, not only in kind but also in degree. Is a dairyman less dependent on his cows than an ant? What organism, other than man, could be more dependent on others for food and survival during childhood and even adolescence? Infants are certainly more helpless than many, if not most, mammals at birth. *Homo sapiens* is even less adequately able organically to synthesize the vitamins necessary for his growth and development than is the lowly bread mold. Have any of these types of dependency any causal relationship with degeneration?

Socially we depend upon one another for the proper maintenance of all aspects of civilization. Industrialization and specialization in research are obvious facets of the interdependence of men. Is an employer less dependent on his workers than the queen bee upon its workers?

Sweden is usually cited as the nation that has developed its consumer cooperative movement more than any other. In my book, cooperation is a form of voluntary dependency, which acknowledges the universal, economic interdependence of men in modern society. "Swedes" have not impressed me as having sunk to "abject subserviency," nor do I recall any slave castes in Sweden.

If degeneracy appears imminent, it may be because of our extravagance with natural resources and because of the days of overpopulation in the foreseeable future. The lack of proper diet that will result can cause the degeneration of coming generations. For biological as well as economic reasons, an atomic war may cause racial degeneration. These are imminent dangers and sources of possible degeneration; compared with them, the likelihood of degeneration owing to a welfare state seems a remote possibility at most.

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11 July 1955

The thesis that social problems can be solved by applying biological principles can only retard the progress of the social and the psychological sciences. Human societies develop historically, not biologically. Man has changed very little from the biological viewpoint in many thousands of years, and yet he has lived in a series of very different societies that have evolved one from the other as his productivity has grown. Along with changes in his social organization go changes in his ideas resulting from, and also contributing to, the changes in society. Biol-

ogy alone gives us no understanding of the different forms of society, the varying content of ideation, or the resulting problems. The principles governing the behavior of the language-using, concept-forming human species include biological principles but are by no means limited to them.

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27 June 1955

Stunkard alludes to the "welfare state" in very broad and damaging statements. In contrast to the closely knit and well-defined biological descriptions, he not once in the article gives one definition, one economic, or sociological description of this "welfare state." I would think that if one wishes to make an analogy between two things, one would define and describe these two things in as definitive a way as one's knowledge enables him to do.

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5 July 1955

I find somewhat disturbing Stunkard's reasoning in his interesting essay. He described the physical changes in the structures of animals that have changed from a free-living to a fixed, communal or parasitic condition. These changes he characterizes as regressions and argues from there that this will be the fate of man if he also should follow the same "slippery path."

This application of a heterogenous collection of zoological facts to human society is clearly indicated by the title. Certainly *freedom, bondage,* and *welfare state* are terms that can be applied to animals only by the broadest poetic license. Initially Stunkard draws a parallel between the free state of an animal in which it independently secures its food and fights in various ways for the privilege of reproduction and the human concept of freedom.

These two concepts however are by no means the same thing. No champion of human freedom ever intended the word *freedom* to mean that man should revert to a savage state. Instead freedom has always meant, in human terms, the right of a man to live and believe as he wishes so long as those wishes do not deprive his neighbor of his inherent freedom—in other words, not only respect for his own rights, but a deep and equally binding respect for the dignity of others. This is our classical concept of freedom, and cannot be applied to the hunting and reproductive habits of wild animals.

Stunkard furthermore implies that certain anatomic changes resulting from adaptation to a static living habit are symptoms of "degradation" of the animal. Is it Stunkard's opinion that the species of Gephyrea he mentions are any the less happy and contented because metamerism is lost? that *Echiuris* leads an unfulfilled existence because in the adult several pairs of mesoblastic somites are lost? that the flatworms mourn forever the loss of their cilia? or that fleas and lice are degraded and shamed by the absence of wings?

The obvious fault in this reasoning is that Stunkard uses the word *regression* not only in a scientific sense, meaning a return down the evolutionary path, but also in a moral and human sense, meaning falling into evil or shameful ways. Regression in evolutionary terms cannot be judged morally, since moral issues are not involved. It can be regarded only as successful or unsuccessful.

Freedom is a product of our human society, as is bondage and the welfare state. The sources and structure of freedom will not be found in an investigation of the sexual or feeding habits of the annelids. Nor can a "welfare state" be even slightly understood by studying the bee.

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22 June 1955

On Brain to Body Ratios and the Evolution of Intelligence

In his paper on the brain to body weight ratios of mammals [*Science* **121**, 447 (1955)], H. J. Jerison uses the data from my monograph [*Ann. N.Y. Acad. Sci.* **46**, 933 (1947)] as the basis of his discussion, but he develops his theme solely, I believe, out of the well-known Dubois formula, $E = kP^{\beta}$ (obviously identical with the Huxleyan "allometric" formula, $y = ax^{\beta}$). He concludes: "Deviation from the expected brain weight in the primates can be accounted for by assuming a special evolution of the brain in the direction of the development of additional cerebral tissue, the weight of which is independent of the body weight."

There is not space to document the fact that others besides myself have found the Dubois formula shaky ground. I do not believe that anyone today would advance it on such slim technical premises as Dubois did. Let me simply point out that (i) over decades quite a few investigators have accepted the formula without critical examination and have developed consequences from it that are no safer than their foundation; (ii) the formula simply fails to fit more than a small middle range of mammalian data, leaving data beyond either end—extensive arrays—uncovered. (This is obvious even to the eye in Jerison's adaptation of my figure.) (iii) Whatever the shortcomings of my monograph are (and it has them), it finds that all extant mammalian data—including data on primates and man himself—can be subsumed under one common mathematical formula or pattern. In other words—any notion that man is aberrant among mammals simply disappears—insofar as my formulation has any validity.

I believe that the principle of Occam's razor demands that we first explore for mathematical formulations that do not require such speculative bolsterings as that just quoted. And apart from logical economy, the notion that primates peculiarly develop "additional cerebral tissue, the weight of which is independent of the body weight," seems to me an unseizable form of theoretical biology.

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12 May 1955

E. W. Count's criticisms should be understood in terms of the basic aims of my paper. I was most concerned with developing an anatomical measure that could serve as an independent criterion for comparing species in terms of intelligence, and I sought to develop the measure from simple assumptions about the evolution of the brain. The relationship between brain weight and body weight was chosen, not because it is necessarily fundamental, but because the "index of cephalization" developed from this relationship had been the only measure at all related to our guesses about the relative intelligence of contemporary mammals (*1*). As I have shown in my paper (*2*), inconsistencies in that index limit its usefulness, and a reanalysis of the problem was necessary.

In attempting this reanalysis I accepted as a first premise that, regardless of intelligence level, a larger body would necessarily require a larger brain, because more tissue would have to be controlled. The problem was then to decide on a function relating brain weight to body weight. One of Count's main criticisms is of my choice of the "allometric size function" for this relationship. He would have preferred, I assume, that his function

$$\log E = k_1 + k_2 \log P - k_3 (\log P)^2$$

be used (E is brain weight, P, body weight, and k_i, constants). Although I was familiar with Count's equation, I chose to use the simpler and more conventional allometry formula, because, in spite of Count's suggestion that this formula does not fit the data adequately, a statistical, rather than an intuitive, test of goodness of fit indicates that the allo-