

SCIENCE

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THE ORGANIZATION OF RESEARCH¹

BEFORE delivering my paper I wish to confess that I find myself in a somewhat unpleasant predicament, for when I began it and even after sending its title to Professor Allee I was of the opinion that research might, perhaps, be amenable to organization, but after thinking the matter over I was compelled to reverse my opinion, with the result that what I shall say may strike some of you as painfully reactionary. Still I encouraged myself with the reflection that many others have written papers with misleading titles and that I might perhaps put much of the blame for the results on my confrères of Section F for conferring so signal an honor as its chairmanship on one of its tired old bisons from the taxonomic menagerie instead of on one of its fresh, young bulls from the Mendelian byre. I might say also, in further justification of myself, that I at least selected the most fashionable and exalted topic I could find, for you must all have observed that at the present time no word occurs with greater frequency and resonance in serious discourse than "organization." Everybody is so busy organizing something or inciting some one to organize something that the word's subtly concealed connotations of control and regulation appear to be overlooked. The purpose of organization is instrumental, as is shown by the derivation of the word, from "organon," a tool, or implement, which is

¹ Address of the retiring vice-president and chairman of Section F—Zoological Sciences—American Association for the Advancement of Science, Chicago, 1920.

in turn derived from "ergo," to work. It is one of those superb, rotund words which dazzle and hypnotize the uplifter and eventually come to express the peculiar spirit or tendency of a whole period.

These words, which for want of a better term I may call "highbrow," and the conceptions they embody, are so interesting that I will dwell on them for a moment. During the late Victorian period the most high-brow word was "progress." It disappeared and gave place to organization with the World War when we realized that the evolution of our race since the Neolithic Age was not nearly as substantial as we had imagined. Neither the Greeks nor the people of the Middle Ages seem to have had either of these words or their conceptions, though the Greeks, at least, did a fair amount of progressing and organizing. The Mediæval high-brow words were "chivalry" and "honor," the latter persisting down to the present day in Continental Europe in the German students' duelling code, as a living fossil, or what biologists would call a "relict." Schopenhauer² remarked that the duel and venereal diseases were the only contributions to culture the race had made since the classical period, overlooking the fact that the Greeks and the Japanese had their own high-brow words and institutions. Gilbert Murray³ has shown that the word "aidos," which the Achæan chiefs

² Zwei Dinge sind es hauptsächlich, welche den gesellschaftlichen Zustand der neuen Zeit von dem des Alterthums, zum Nachtheil des ersteren unterscheiden, indem sie demselben einen ernsten, finstern, sinistern Anstrich gegeben haben, von welchem frei das Alterthum heiter und unbefangen, wie der Morgen des Lebens, dasteht. Sie sind: das ritterliche Ehrenprincip und die venerische Krankheit—*par nobile fratrum!* Schopenhauer, "Parerga und Paralipomena," Ed. Frauenstädt, Vol. 5, 1888, p. 413.

³ "The Rise of the Greek Epic," 2d Ed. Oxford, Clarendon Press, 1911, pp. 103-112.

of the Homeric age so solemnly uttered, was applied to a peculiar kind of chivalry, and the "bushido" of the Japanese was another similar though independent invention. All of these conceptions—progress, organization, chivalry, aidos, bushido—seem to start among the intellectual aristocracy and all imply a certain "noblesse-oblige," for there is no fun in continually exhorting others to progress unless you can keep up with the procession, or of organizing others unless you yearn to be organized yourself, just as there is no fun in getting up a duelling or bushido code unless you are willing to fight duels or commit harakiri whenever it is required by the rules of the game.

Of course, the vogue of "organization" was abnormally stimulated by the mobilization of armies and resources for the World War. We acquired the organizing habit with a vengeance and have not since had time to reflect that there may be things in the world that it would be a profanation to organize—courtship, *e.g.*—or not worth organizing—a vacuum, *e.g.*—or things that can not be organized, or if organizable, better left as they are—scientific research, perhaps.

There are at least three different types of organization. One of them we find ready to hand in individual animals and plants, in our own bodies and in animal colonies and societies, *i.e.*, in complexes which organize themselves both onto- and phylogenetically. This is a self-contained type of organization, requiring much time and energy for its consummation and though very intricate and profound still sufficiently plastic and adaptable to trade with time and the environment and to resist a considerable amount of thwarting and meddling. For obvious reasons this type appears to us to be so admirable that it influences all our conceptions of organi-

zation. If the Greeks had coined a word for organization—the nearest word, *orgánosis*, seems not to appear till the twelfth century—they would probably have applied it to a second type of cases, in which an agent organizes a complex as an engine for accomplishing certain results. In this sense Mr. Ford would be an organizer of motor cars and in such a sense theologians might speak of the Deity as organizing the universe. This is organization imposed on inorganic or at any rate alien materials. At the present day the word is not used in this sense, since the notion of life in the materials to be organized seems to be so essential. There is, however, a third type, which is intermediate between the two preceding, one in which certain elements of a living complex are permitted or delegated or arrogate to themselves the right to organize the remaining elements, as is seen in innumerable human organizations from a state, church or army to a band of robbers. This type of organization, can often be swiftly accomplished, especially if reinforced by the first type, but is necessarily more or less of an artefact and prone to easy and unexpected disintegration. We have this type in mind when we speak of the organization of scientific research, or investigation. It is evident, moreover, that the organization of research up to the present time has developed according to the first type, through a natural division of labor and inclination among investigators and by means of such cooperative *liaison* agencies as learned societies and publications. Even the most pessimistic among us must be lost in admiration at the results thus accomplished during the past few centuries. But the organizers feel that we have been moving too slowly and have been wasting too much time and effort—and they also feel, apparently, that natural, or organic organization of research, like that

of the past, affords too little scope for the expression of those instincts of self-assertion and domination, which are so evidently associated with the accumulation of hormones in the older males of all mammals. These hormones commonly produce such an obfuscation of the intellect that even our mature biologists seldom realize that they are headed for the fate of the old rogue elephants and bulls, which, when they try to do too much organizing, are promptly and unceremoniously butted out of the herd by the youngsters.

The phrase "organization of research" is nonsense if we take "research" in its abstract sense, for an abstraction, of course, is one of the things that can not be organized. All we can mean by the term is the organization of the actual processes of research, or investigation, and since these processes are essentially nothing but the living, functioning investigators themselves, organization of research can mean only the organization of the investigators. It would seem desirable, therefore, before attempting such organization to make a behavioristic study of these creatures—either to catch and closely observe a number of them or to steal on them unawares while they are in the full ardor of research—in other words to investigate the investigators. Unfortunately no one has made such a study, which should, of course, precede the making of a card catalogue of the various species, subspecies, varieties, mutations and aberrations of investigators and the enumeration of their genes and chromosomes. And as the investigators themselves seem to be so busy that they have no time to scrutinize their own behavior, or if they do, are either too proud or too bashful to tell us what they find, I am compelled, for the sake of my argument, to attempt such a study and hence to make a brief excursion into psychology. As this

is one of the fields in which it is still possible to do a certain amount of loose thinking with impunity. I may hope to return sufficiently intact to proceed with the discussion.

It is often supposed that the investigator enters his laboratory full of instruments and glassware and proceeds, with the use of this equipment, his sense organs and his carefully controlled ratiocinative powers to excogitate the discoveries which our newspaper editors occasionally deign to distort for the benefit of the readers of their Sunday supplements. But every investigator who observes his own activities or those of other investigators knows that this is, to say the least, a very inadequate account of the process, and every psychologist knows that while the proper employment of the senses and the reasoning powers is extremely important, the real "drives" are the instincts, emotions and interests, or what some authors prefer to call in more anæmic terms, the propensities, conative tendencies, sentiments or dispositions. To the biologist, who takes a behavioristic view of the instincts, it is difficult to single out the various drives that initiate, determine and sustain such intricate activities as those leading to scientific discovery and invention, and the psychologists themselves are far from unanimous on this matter. The list submitted in the sequel is, therefore, merely an approximation to the true state of affairs, though it is probably adequate for the purpose I have in mind.

To merit the designation of human instincts, in the conventional sense, tendencies or dispositions must be innate and purposive, common to all the normal individuals of our species, less overlaid or camouflaged by habits and therefore more evident in the young than in the adult and represented by similar though more rudi-

mentary tendencies in the higher mammals. Such instincts seem to be rather numerous and several of them are exhibited by the investigator in a highly specialized form or are at any rate evoked and conditioned by very specific objects or situations. We can recognize:

1. Curiosity, which seems to be clearly manifested in many mammals, like the cow which stares at us across the pasture, and in the open-mouthed wonder of the child. It is so characteristic not only of individuals but of whole peoples that the Germans often refer to it as a national peculiarity of the Saxons. In the investigator it is commonly insatiable and very intense, because restricted to certain objects and relations, particularly to the causal relations among phenomena. Its importance has been noticed by many writers. McDougall⁴ says that in men in whom curiosity is innately strong, "it may become the main source of intellectual energy and effort; to its impulse we certainly owe most of the purely disinterested labors of the highest types of intellect. It must be regarded as one of the principal roots of both science and religion." It is perhaps worthy of note that "inquiry" is often used as a synonym of investigation, and that any problem is most naturally and most concisely stated in the form of an interrogatory sentence.

2. The hunting instinct, which is primarily nutritive in animals and remains so very largely in savages. In children and adults of civilized man it persists in the form of sport and the love of rapid movement in such intensity that it is leading to the extinction of our native faunas and an enormous development of the automobile industry, while in the investigators—the word itself means followers of an animal's spoor—such as zoologists, archeol-

⁴ "An Introduction to Social Psychology," Boston, Luce & Co., 1910, p. 59.

ogists and explorers it is too apparent to require discussion. It is not lacking, however, in other investigators, all of whom when too old or too lazy to hunt their accustomed prey in the open, delight to sit and hunt for the opinions of others and especially for confirmation of their own opinions, in comfortably heated libraries.

3. The acquisitive, collecting or hoarding instinct, also primarily nutritive in animals and savages, but modified in children and adults of civilized peoples, in whom it manifests itself in the most extraordinary form of amassing all sorts of objects, from newspaper clippings and cigar-bands to meerschaum pipes and shaving mugs. It is unnecessary to dwell on its truly monomaniacal manifestations among zoologists and botanists, who collect everything from mites to whales and from bacteria to sequoias. But even those who look down with contempt on the enthusiastic collectors of bird-lice or coprolites are themselves usually addicted to collecting so-called data or statistics. The significant difference between the mere magpie-like collector and the hamster-like investigator lies, of course, in the use made of the accumulated objects.

4. The instinct of workmanship, craftsmanship or contrivance, which also has its phylogenetic roots in the constructive activities of very many animals. In man it begins ontogenetically with the making of mud-pies and may lead to such achievements as the excavation of the Panama Canal or the construction of an airship. It is, as Veblen⁵ and others have shown, an instinct of the greatest importance. In the investigator it is seen in the inventing of methods and devices and the construction of apparatus and hypotheses, and

reaches its highest manifestations in flights of the creative imagination.

The four instincts I have been very briefly considering might be called individual to distinguish them from four others which are more deeply rooted in the social life of the investigator. These are:

5. Emulation. The decision as to whether this may be traced among animals to competition for food or for mates may be left to Jung and Freud and their respective disciples. According to William James,⁶ emulation is "a very intense instinct, especially rife with young children or at least especially undisguised. Every one knows it. Nine tenths of the work of the world is done by it. We know that if we do not do the task some one else will do it and get the credit, so we do it." It is powerful and elaborately conditioned in investigators and perhaps the less said about it the better. The word "priority" will conjure up in your minds a sufficient number of emotionally toned ideas to meet the needs of this discussion.

6. What for lack of a better term I shall call the instinct of communication. It seems to have its roots in the behavior of those more or less gregarious or social animals, which apprise one another by signs or sounds of the presence of danger, of food or of certain sexual states. Its manifestations may be said to range from the chirping of crickets, tree frogs and birds to the invention of language and the effusions of poetry and music, both vocal and instrumental. In both the old and the young of our species it appears also as the by no means sex-limited impulse to gossip and divulge secrets, to communicate news and rumors, much information and no little misinformation. It urges the investigator to communicate the results of

⁵ "The Instinct of Workmanship," N. Y., B. W. Huebsch, 1918.

⁶ "The Principles of Psychology," N. Y., Holt & Co., Vol. 2, p. 409.

his activities to learned societies and to publish those results to the world or at least to a select coterie of specialists. The strength of this instinct might be tested by passing stringent laws forbidding certain investigators from attending scientific meetings or publishing anything for long periods of time or during their life-time or even posthumously. The results of such experimental repression might be illuminating but I refrain from speculating on their nature.

7. Closely connected with this instinct of communication is the craving for sympathy and appreciation so clearly exhibited by most highly social animals and so undisguisedly shown by children. Most investigators exhibit such a moderate development of this craving that they seem to be quite satisfied with the good opinion of the workers in their own specialties. But even if more appreciation were demanded the individual investigator would stand little chance of obtaining it, for investigators have become so numerous and the field of their labors has been so vastly expanded through their own enthusiastic efforts and so thickly overgrown with a dense crop of technicalities of their own sowing and cultivation, that most of them can be known only to those who are working in the same or adjoining furrows.

8. The instinct of cooperation—also very evident and of far-reaching significance in gregarious and social animals and manifested in the team-play of young human beings and the innumerable associations of adults. In many investigators this instinct seems to be rather feeble but may still appear at least in the ambition to figure in the rôle of an honest hod-carrier in the erection of some small fragment of the great edifice of human knowledge. In others it may be sufficiently developed to constitute a powerful drive to the inven-

tion of labor-saving devices and machinery, methods of preventing disease and increasing longevity and mental and physical efficiency.

This list is probably incomplete, but I believe that it comprises at least the more important drives of the investigator. The special trend of his activities is, no doubt, further determined by his native capacities, but the psychological problem as to whether or not these also constitute drives, as Woodworth⁷ maintains and McDougall⁸ denies, I shall not attempt to discuss. The point I wish to emphasize is that the specific activities of the investigator depend primarily and preeminently on his instincts, emotions, interests and native endowments.

If we turn now to a survey of investigators in general we find that they can be divided into two classes, usually called theoretical and practical, or pure and applied. The term pure is, to say the least, somewhat priggish, since it seems to imply that its alternative is more or less contaminated, and theoretical and practical are unsatisfactory because all investigation is necessarily both. I prefer, therefore, to designate the two classes as discoverers and inventors, since the former are primarily interested in increasing our knowledge of our environment and of ourselves, the latter in increasing our power over our environment and ourselves. From the very nature of this distinction it follows that the discoverer pursues more general, more theoretical and therefore more remote aims, whereas the inventor, in the very broad sense in which I am using the term, busies himself with more special, more practical and therefore more immediate problems.

⁷ "Dynamic Psychology," N. Y., Columbia Univ. Press, 1918, pp. 66 *et seq.*

⁸ "Motives in the Light of Recent Discussion," *Mind*, 29, N. S., 1920, pp. 277-293.

As both types of investigation are equally essential to the fullest spiritual and economic exploitation of the universe, no society can attain to a high level of culture unless it provides impartially both for its discoverers and its inventors.

There is another classification of investigators which will be useful for the purposes of my argument—namely, into professionals and amateurs. I am, of course, using these words in their good sense, not with the evil connotations that have grown up around them. It is clear that both may suffer from certain disabilities, the professional from well-known guild restrictions, the amateur from lack of opportunity or equipment or of the lively interchange of ideas so necessary to the most fruitful type of investigation. Both, too, have their advantages, the professional in the support and advertisement of his guild-fellows, the amateur in the freedom to choose and delimit his own problems, to work on them in his own way and to publish when he sees fit. These distinctions did not escape that clever old fox, Samuel Butler, who says:⁹

There is no excuse for amateur work being bad. Amateurs often excuse their shortcomings on the ground that they are not professionals, the professional could plead with greater justice that he is not an amateur. The professional has not, he might well say, the leisure and freedom from money anxieties which will let him devote himself to his art in singleness of heart, telling of things as he sees them without fear of what man shall say unto him; he must think not of what appears to him right and lovable but of what his patrons will think and of what the critics will tell his patrons to say they think; he has got to square every one all round and will assuredly fail to make his way unless he does this; if, then, he betrays his trust he does so under temptation. Whereas the amateur who works with no higher aim than that of immediate recognition betrays it from the vanity

and wantonness of his spirit. The one is naughty because he is needy, the other from natural depravity. Besides the amateur can keep his work to himself, whereas the professional man must exhibit or starve.

Contrasting the professional and amateur, to the advantage of the latter, was also a favorite pastime with that irritable old bear, Schopenhauer.¹⁰ He compared the professionals with dogs, the amateurs with wolves, but he was not always consistent zoologically, for he sometimes thought of the professionals as cattle, as *e.g.*, when he says:

On the whole, the stall-feeding of our professorships is most suitable for ruminants, but those who receive their prey from the hands of Nature, live best in the open.

At present the terms professional and amateur seem to have fallen into disuse among scientists, for reasons that are not far to seek. We know that during the eighteenth and nineteenth centuries, when the books and apparatus necessary for the prosecution of research were so meager as to be within the reach of men of very moderate means, amateurs were able to do a vast amount of important work in all the departments of science. This was particularly true in England and America. In England we have a teacher of music, Wm. Herschel, making great discoveries in astronomy; a stone-cutter, Hugh Miller, in geology; a Nottingham cobbler, George Green, in mathematics; a grocer of Ightham, Harrison, and a jeweller of St. Leonards, W. J. L. Abbott, in archeology, and a country gentleman, Charles Darwin, in biology. There were men like John Hunter, Lyall, Wallace, Galton, Samuel Butler, Lubbock, Bates and a host of other eminent investigators, who really belonged to the class of amateurs. Till very recently whole sciences, such as taxonomy and

⁹ "The Notebooks of Samuel Butler." Edited by H. F. Jones. N. Y., E. P. Dutton & Co., 1917, p. 145.

¹⁰ *Loco citato*, Vol. 6, p. 519.

zoogeography, entomology and genetics were almost entirely in the hands of amateurs. Mendel was an amateur and all the wonderful varieties of our domestic animals and plants were developed, one might almost say invented, by amateurs. The change which has come over the situation is due to the great increase in our knowledge in more recent times and the exuberant growth of our universities, technical schools, museums and research institutions. These have made investigation more and more difficult for the amateur, especially in the inorganic sciences and in physiology, which now demand an exacting preparation and elaborate apparatus, although there are even at the present time a few eminent amateur astronomers and geologists. Amateurs still abound, nevertheless, in zoology and botany, in which it is still possible to carry on much valuable research with very simple equipment. There must be thousands of them, and nothing is more extraordinary than the ignorance of their work on the part of many of our university professionals. I could give a long list of men in the most diverse professions, lettercarriers, stage-coach drivers, hosiers, portrait-painters, engravers, parsons, priests, stockyard superintendents, engineers, bankers, country-grocers, country-doctors, army officers, mining prospectors, school teachers and clerks, whose researches have greatly enriched entomology and other departments of zoology. In such vast and complicated sciences as biology and archeology the work of the amateur is so much needed and so worthy of encouragement that we may regard it as one of the greatest defects of our educational system that a youth is ever able to leave the science courses of a high school or college and take up the humblest calling, without a fixed determination to fill at least

a portion of his leisure hours with the joys of research.

The disuse of the words professional and amateur is also, no doubt, due to the fact that the two kinds of investigators can no longer be sharply distinguished. Not only are the biologists in our universities and museums frequently recruited from the ranks of the amateurs, but as investigators in those institutions many of them remain amateurs in spirit and merely exercise the teaching and curatorial professions because they can be more conveniently carried on in conjunction with research than more lucrative professions such as undertaking and plumbing. There is no reason to suppose that the number of amateur investigators may not greatly increase under a more favorable form of society. In the ideal commonwealth of the future it may not be in the least surprising to find that the communal furnace-man, after his four-hour day, is conducting elaborate investigations in paleobotany, and that the communal laundress is an acknowledged authority on colloidal chemistry.

Now if the preceding very hasty behavioristic account is accurate we must admit that it would be difficult to find a body of men more unfavorable for purposes of organization, even by a committee of their own class, than the investigators. Many reasons might be given in support of this statement, but I shall consider only the following four:

1. The activities of the investigator depend as we have seen, on an array of instincts, emotions and interests, many of which are so positive that their organization in the sense in which organizers are using the term, is out of the question. It is possible, of course, to overstimulate, repress, pervert and exploit instincts and they are undoubtedly able to organize

themselves by long processes of interplay, mutual adjustment and coordination, but even regulation of them *ab extra* is exceedingly difficult. In this matter the experience of the race in its age-long endeavors to regulate and organize such powerful drives as the sexual and parental instincts should be sufficiently illuminating, and the instincts of the typical inventor and discoverer seem to be every bit as imperative. The impossibility of organizing even a small body of investigators can be easily tested. Such bodies exist in our large universities, very small in comparison with the total number of investigators in the country, but large enough, if organized, to determine and control the whole policy of their respective institutions. But if any investigator attempts to organize such a body for such a purpose or for any other of mutual advantage, he will at once find his efforts frustrated or, at any rate circumvented, by a lot of individuals, turgid with peculiar instincts, emotions and purely personal interests and as blind to their collective interests as an equal number of soft-shell clams. Furthermore, it is important to note that the difficulties of organizing are greatly increased by the skeptical and critical attitude of mind which the investigator is bound to cultivate and the defective development of certain dispositions in his constitution, such as the gregarious instinct and the instinct of self-abasement and susceptibility to suggestion, propaganda and leadership, which render other men so prone or at least so accessible to social, religious and political organization.

2. Attempts at organizing investigators must fail because their highly specialized activities depend to such a great extent on their peculiar native aptitudes or capacities. The organizers are willing to admit that they are baffled by the geniuses, but

these are dismissed as very rare birds, notwithstanding the fact that their influence on the trend of scientific research is out of all proportion to their numbers. The great majority of investigators appear on superficial acquaintance to be such commonplace, unassuming specimens of humanity that it would seem that they and society in general could only be greatly benefited by having their problems "assigned" and their investigative efforts directed, controlled and organized. This notion seems to me to be due to a singularly defective insight into the peculiar psychology of investigators. No one who has had long and intimate relations with these men can fail to be impressed with the extraordinary diversity of their aptitudes, and nothing is more evident than that these aptitudes must be permitted to express themselves not only with the greatest freedom, but even in the most whimsically personal manner. Nor can any one who is running a laboratory fail to notice that he can secure the fullest enthusiasm, devotion and team-play from all his men only on the condition that all considerations are absolutely subordinated to the ideals of research. He knows that some investigators can do their work best with a slow, uniform and apparently never-tiring motion, others with a ravenous, carnivore-like onrush, accompanied by an expenditure of vitality so magnificent that they have to loaf for a considerable period before they can store sufficient energy for another onslaught on their problem, and that there are many others whose investigative activities are of an intermediate and more evenly rhythmical type. Yet men of such diverse aptitudes and habits of work can be easily induced to live in harmony and accomplish much valuable work if any suggestion of such things as punctuality, punching time-clocks and other efficiency

and factory devices are most carefully avoided. So sensitive is the investigator to the need of giving expression to his capacities and of doing his work in his own way, that any one who is enough of a martinet to insist on introducing any of the devices to which I have alluded, will at once build up a defence reaction sufficiently powerful to vitiate or inhibit all the research activities of his laboratory. It is for this reason, I believe, that even the vague, tentative suggestions of the organizers are already creating a resentment or at any rate a resistance that would surprise no one who is not bent on behaving like the proverbial bull in a china shop.

3. Whatever may be the value of research to the individual investigator, it is certain that its only social value lies in the discoveries and inventions to which it may lead. The investigative genius may be defined as one who is in a chronic state of discovery or invention, whereas the ordinary investigator approximates genius more or less closely according to the frequency of his creative achievements. Now such essential achievements, both chronic and occasional, can not be included in any scheme of organization for they usually lie outside the purview of the investigator himself or depend on situations over which he has no control. Discovery and invention are in this sense fortuitous or accidental and also involve a time factor which is equally unpredictable and unorganizable. The investigator, if you will pardon my emphatic language, can only do his damndest and hope that the new truth will deign to ascend from the subconscious or descend from the lap of the gods. After long and tedious observation or experiment and many disappointments he may or he may not find the discovery or invention flashing suddenly and more or less com-

pletely into consciousness or emerging from some happy constellation of events. The plant-physiologist Sachs once told me that his best ideas suddenly entered his mind in the morning while he was lacing his shoes or brushing his teeth. I have noticed in my own case that the few unimportant ideas that strike me as unlike those which ordinarily infest my waking consciousness emerge suddenly while I am passing a certain vacant lot on my morning trip to my laboratory. Not improbably my single cup of breakfast coffee may be a stimulus so timed that the reaction coincides with the vacant lot. I hasten to confess, however, that the outline of this paper was not picked up in a vacant lot, as its miscellaneous contents might lead you to suppose, but came to me, probably after prolonged subconscious incubation, while I was wondering how much coal I could save by using as an "Ersatz" the literature received during the past three years from that noble superorganization of superorganizers, the National Research Council.

4. I have dwelt on the amateurs, because they seem to me to form another insuperable obstacle to the organization of research, at least in the biological field, where they constitute a very large and important "bloc" of investigators. While one might be pardoned for supposing that some of the house-broken or domesticated investigators, who indulge in what is called "institutional" or "industrial" research might be organized after a fashion, it would be unpardonable to suppose that the wild, untamable amateurs would ever submit to such an indignity. These seem to be described as "solitary workers" in some of the literature I have received—why, I can not say. The amateur, as the word implies, is a lover, and all the world loves a lover, no matter how wild, or just because he is

wild. Certainly the many members of our numerous natural history, ornithological, entomological, malacological, botanical and mycological clubs, who hold monthly meetings and contribute modestly but effectively to the sum of our knowledge, regard themselves as anything but "solitary" workers. That designation would seem to be more applicable to some of the professionals in our universities and research institutions.

Of course, the organizer who has been stung by the efficiency bug, is troubled by all this diffuse and elusive activity and counters with the assertion that organization would save duplication of effort and direct it to problems of fundamental importance. This takes for granted a knowledge of the fundamental problems on the part of the organizer and a most enviable intuition of the means adapted to their solution, or, at any rate, seems to imply that working on fundamental problems means *eo ipso* making important discoveries and inventions. The contention that we must avoid duplication of effort must have had its origin in a machine shop or a canning plant, for it certainly never originated in the brain of any investigator worthy of the name. That the establishment of the simplest item of our knowledge not only requires duplication, but reduplication and re-reduplication of effort, is too obvious to require discussion, as is also the fact that we always regard the agreement in the results of two or more investigators working independently as presumptive evidence of truth. I would similarly pass over the further implication in the arguments of the organizers, that the only value of an investigator's work lies in the scientific data and conclusions which it contains, and that we are not concerned with its unconscious revelations of habits of thought, personality, etc. The perusal of the works of the

great amateur entomologists, Réaumur and Fabre, might be recommended for those whose minds are in such a ligneous, arenaceous or argillaceous condition.

The suggestion that scientific research may be advantageously organized naturally leads one to consider those other great human activities, religion and art, which are also bound up with powerful instincts, emotions and interests. Certainly religion, especially in the form of dogma and ritual, has been so superbly organized *semper ubique et omnibus*, since it first arose in the totemism, taboo and magic of our savage ancestors, that it would seem to constitute a wonderful field for the study of both the blessings and curses of organization. It is, in fact, a field in which organization could be readily introduced and maintained owing to the proneness of so many human beings to suggestibility, credulity, the gregarious instinct, the instincts of self-abasement and fear, and the sentiments of awe and reverence—all of which, be it noted, are singularly feeble or defective in the investigator. The same conclusion would seem to follow from the very different view of some of the Freudians who state that all religions are permeated by a subterranean feeling of guilt and that "this absolutely unfailing presence of the feeling of guilt shows us that the whole structure of religion is erected on a foundation of repression of instinct."¹¹ That the perfection of organization so characteristic of religion may have been beneficent in other times may be admitted, but the more nearly perfect an organization, the less it is able to adapt itself to changing conditions, and the World War has disclosed to all thinking men the same kind of hopeless, resourceless

¹¹ Cf. O. Rank and H. Sachs, "The Significance of Psycho-analysis for the Mental Sciences." Transl. by C. R. Payne. Nervous and Mental Disease Monographs, No. 23. N. Y., 1916, p. 71.

overspecialization in our ecclesiastical organizations as that with which the biologist is so familiar in archaic, moribund and actually extinct species. At the present time the Church seems to be about as well adapted to piloting the great forces which are impelling society as is a two-toed sloth to piloting an airplane or a manatee the Twentieth Century Limited. Like the Edentate and the Sirenian the Church exhibits such feebleness of volition and muscular tonus and such a low ebb of creative energy, that one is inclined to find a modicum of truth in the aphorism which H. G. Wells saw posted by the bolsheviki on one of the houses in Moscow: "Religion is the opium of the people."

What a different picture is presented by that other great field of human activity, in which the instinct of workmanship and the creative imagination attain their finest and most unrestrained expression—the field of art! Its very life seems to depend on freedom from all imposed organization. Hence its plasticity and adaptability in all ages and places, its resilience and prompt resurgence after periods of conventionalization, or overspecialization. Unlike the religious person who seems always to be mistrusting his instincts, or the scientific investigator who is so sophisticated that he ignores them, the artist takes them to his bosom, so to speak, and in all his works tries to persuade the rest of the world to do the same. He thus becomes the ally of creative Nature herself and while himself capable of such control and restraint as are demanded in the harmonious execution of his work, quickly resents the slightest suggestion of restraint or control from the outside. This is so well known that one would find it more entertaining than informing to hear the comments of a lot of painters, sculptors, composers, poets, novel-

ists and actors—and especially of a lot of actresses or prime donne—if some National Art Council had the temerity to suggest that their work could be greatly improved by organization.

The history of science and philosophy is not without significance in connection with the attempts of modern organizers. It is well known that both, after their twin-birth and brilliant childhood among the Greeks, lived through a kind of stupid Babylonian captivity as hand-maidens to the Mediæval Church, which had been so successful in organizing itself that it naturally tried to organize everything else. But science turned out to be such an obstreperous and incorrigible tomboy that she long since regained her freedom, and philosophy, though she had been treated with more consideration, and may still occasionally flirt, no longer, outside of our Jesuit colleges at least, sits down to spoon with theology as she did in the days of St. Thomas of Aquin.

Times have changed so greatly that at present we even have eminent amateurs, like the Rev. Erich Wasmann, S.J., who vie with Haeckel in the boldness of their evolutionary speculations. Scientific research is no longer concerned with the Church but with the two great forces which are contending for the mastery of the modern world, labor and capital. The present plight of the Russian investigators shows us, perhaps, what we may expect when certain communistic ideals of labor are put into practise, and Veblen's account of the evolution by atrophy of the creative artisan of former centuries into the modern factory operative, whose life has been reduced by capital, machinery and efficiency experts to one long hideous routine in some overspecialized task, shows us, perhaps, what we may expect when nothing but money talks.

Even if the investigator could hold aloof and adopt a policy of watchful waiting, till the world is controlled by either labor or capital or, as seems more probable, by some compromise between them, he would still be in an unfortunate position. Since both labor and capital are primarily concerned with production, we should expect both to center their interests on applied research, or invention and to neglect research which is fundamentally concerned with discovery. This would be unfortunate, because the two kinds of research can be most fruitful only in symbiosis, for the neglect of discovery must lead to impoverishment of the theoretical resources of the inventor, and purely theoretical research strongly tends to become socially ineffective. We have as yet, I believe, no concise information in regard to labor's attitude to so-called pure research. The attitude of the capitalist, or business man seems to be much more definite. His activities, like those of the investigator, are bound up with certain powerful, highly conditioned instincts, emotions and interests, some of which have been elucidated by Taussig.¹² He believes that the business man is driven mainly by the acquisitive instinct, centered of course on pecuniary profits, the instinct of domination or predation, the instinct of emulation, in the special form of social emulation, and the instinct of devotion or altruism. Undoubtedly we must recognize also the importance of the instinct of worship as a powerful drive in many eminent business men, but both it and the instinct of devotion are, of course, apt to be directed to practical matters or to those which yield immediate returns, such as philanthropy, charity, medicine, etc. Apart from certain notable exceptions, business

men may, therefore, be expected to favor invention and to take little interest in discovery, except when it relates to natural resources capable of exploitation.

These considerations lead me to the opinion that so long as our present society endures adequate financial and other support for research in its most comprehensive form will be forthcoming only after the general community has thoroughly grasped the fact that of the four great fields of human endeavor, science, art, religion and philosophy, science is of the most overwhelming social value in the sense that the welfare of every individual, physically, mentally and morally, absolutely depends on its developments, or in other words, on scientific research. To saturate the general public with this conviction is a formidable task and one that can be accomplished only by a slow process of education.

There is also another aspect of the subject which I can best make clear by returning to that form of organization which we observe inhering in individual animals and plants and in the societies of the former. Occasionally we find such organisms so highly integrated, differentiated or specialized as seriously to impair their powers of adaptation. When such a condition is reached, the organism either persists without phylogenetic change, if its environment remains stable, or soon becomes extinct, if its environment changes. Most organisms, however, retain a lot of relatively unorganized, or more or less generalized structures and functions as reserves for prospective adjustments to the changing environment. Our own bodies still contain many such primitive elements, like the white blood corpuscles, the undifferentiated connective tissue, dermal and glandular cells, and in larval insects we find even undifferentiated nerve cells. And we all carry with

¹² "Inventors and Money-Makers," N. Y., Macmillan Co., 1915.

us in our subconscious a great reservoir of very primitive instincts and tendencies, many of which are as archaic as those of our Palæolithic and anthropoid ancestors. This whole relatively undifferentiated and imperfectly organized equipment must be of the greatest value as a source of future adaptations.

We are also beginning to see that as civilization progresses it is necessary to maintain a certain number of our activities in a primitive, unorganized condition and for their exercise to set aside hours of leisure and relaxation, vacations and holidays, so that we can escape from the organized routine of our existence. And as the surface of the planet becomes more and more densely covered with its human populations, it becomes increasingly necessary to retain portions of it in a wild state, *i.e.*, free from the organizing mania of man, as national and city parks or reservations to which we can escape during our holidays from the administrators, organizers and efficiency experts and everything they stand for and return to a Nature that really understands the business of organization. Why may we not regard scientific research, artistic creation, religious contemplation and philosophic speculation as the corresponding reservations of the mind, great world parks to which man must resort to escape from the deadening, overspecializing routine of his habits, mores and occupations and enjoy veritable creative holidays of the spirit? These world parks are in my opinion the best substitute we are ever likely to have for the old theological Heaven, and they have the great advantage that some of us are privileged to return from them with discoveries and inventions to lighten the mental and physical burdens of those whose inclinations or limitations leave them embedded in routine. This is

the meaning of that stanza in the witch's song of Faust:

The lofty skill
Of Science, still
From all men deeply hidden!
Who takes no thought,
To him 'tis brought,
'Tis given unsought, unbidden!¹³

Like other members of society, the scientist, artist and philosopher must always devote considerable time and energy to routine occupations, for their lives, with very rare exceptions, are not completely absorbed in research, speculation and creative activity. They might therefore be expected to react rather unpleasantly to any suggestion of meddling with those occupations in which they feel that they can express their personalities with the greatest freedom and the greatest satisfaction to themselves if not to others. It seems to me that it can only be due to the modesty or indifference of scientific investigators that they have failed to voice their opinions of the organizers. The only utterances I have seen are an admirable paper by Professor Sumner¹⁴ and in another field, that of social theory, a few paragraphs by G. D. H. Cole.¹⁵ I will end my paper with these paragraphs, because they express so concisely the conclusions I have reached from a different point of view:

First of all, it is necessary to rid ourselves once and for all of the notion that organization is in itself a good thing. It is very easy to fall into the notion that growing complexity is a sign of progress, and that the expanding organization of Society is a sign of the coming of the Cooperative Commonwealth. A constantly growing measure of cooperation among men is no doubt the greatest

¹³ Goethe's "Faust." Trans. by Bayard Taylor. N. Y., Houghton Mifflin Co., Vol. 1, 1912.

¹⁴ "Some Perils which Confront us as Scientists," *Scient. Monthly*, March, 1919, pp. 253-274.

¹⁵ "Social Theory," N. Y., Stokes Co., 1920, p. 185.

social need of our day; but cooperation has its unorganized as well as its organized forms, and certainly the unorganized cooperation of men, based on a sheer feeling of community, is not less valuable than organized cooperation, which may or may not have this feeling of community behind it. It is easier to do most things with organization than without; but organization is to a great extent only the scaffolding without which we should find the temple of human cooperation too difficult to build.

To say this is not to deery organization; it is only to refrain from worshipping it. Organization is a marvelous instrument through which we every day accomplish all manner of achievements which would be inconceivable without it; but it is none the less better to do a thing without organization if we can, or with the minimum of organization that is necessary. For all organization, as we have seen, necessarily carries with it an irreducible minimum of distortion of human purpose; it always comes down to some extent, to letting other people do things for us instead of doing them ourselves, to allowing, in some measures, the wills of "representatives" to be substituted for our own wills. Thus while it makes possible in one way a vast expansion of the field of self-expression that is open to the individual, it also in another way distorts that expression and makes it not completely the individual's own.

In complex modern communities there are so many things that must be organized that it becomes more than ever important to preserve from organization that sphere in which it adds least to, and is apt to detract most from, our field of self-expression—the sphere of personal relationships and personal conduct.

WILLIAM MORTON WHEELER

NELSON R. WOOD

FOR many years I knew the late Mr. Nelson R. Wood, who suddenly died in Washington on November eighth, and during all those years he was employed in the taxidermical department of the United States National Museum. As a scientific and artistic taxidermist he had not a single equal in this country, and I personally never knew of his peer anywhere in the world. Birds were ever the special objects of his skill, and to the mounting of them for museum exhibition the

greater part of his life was almost daily devoted. While a consummate master with birds of all groups, certain families of them were his especial favorites, and these he preserved in a manner so perfect that they appeared to need but the instillation of life to have them go their way as they did in nature when alive. The forms particularly referred to were the game birds, pigeons, and fowls of all descriptions, and many of these, together with a host of others, are now on exhibition in the cases at the United States National Museum, where they will probably be viewed for many generations to come.

It has been my privilege to publish, in various works both here and abroad, over a hundred of Mr. Wood's mounted specimens of birds and many species—not only those of this country, but of all the Americas, Australia, and other parts of the Old World as well. They have ever been received and spoken of with more than marked approval and highly praised, as they well deserved to be.

It is not easy to estimate the far-reaching loss the death of such a man is to a great museum, where high-class taxidermical work is so essential and so constantly in demand. In the entire history of the scientific art of taxidermy in America, no one has ever left such mounted specimens of game birds, pigeons, and domesticated fowls as Mr. Wood, while in the case of many of the passerine types he was equally skilful. Only a short time before his death he mounted several specimens of crows and jays—single pieces—and the work is the wonder of all who see it. One of our common Crow in particular is the most life-like thing of the kind that one may well imagine; it represents the height of the science in regard to modern taxidermy, which passed, only within comparatively recent time, from the antiquated methods of "stuffing" birds to the practise of imperishably preserving them in their natural poses.

Mr. Wood gained his knowledge of the normal attitudes of birds in nature through his life-long study of them in their various habitats. More than this—he had so skilfully