only for a thin layer, neglecting the absorption of light and electrons in the metal, this agreement appears significant.

As Wentzel is careful to say, the theory so far is so idealized that one must be cautious in attempting to correlate it with experiment. In simplifying the problem from the theoretical standpoint, several factors have been neglected which are just those which the experimenter can not, or at least has not, eliminated. Most important of these is the structure of the surface, which has theoretically been assumed to be *perfectly smooth*. It is doubtful whether experiment can ever deal with a surface approximating this condition. Furthermore, until values of the internal absorption coefficient for both light and electrons are available, either from experiment or from more fundamental theory, the present type of wave mechanical theory will be limited in its application to *thin films*. As we have seen, experimental work with thin films has its own peculiar difficulties, and the results in many cases show new complications rather than the simplifications which one would hope for in order to compare with theory.

The present situation then is that while experiment is providing continually more complicated results, though to be sure they are undoubtedly more reliable and more reproducible, theory naturally asks for simple characteristics obtained under idealized conditions. Perhaps with better controlled experiments and more elaborated theory, we can reach not only an understanding of the fundamental photoelectric process, but also, what is of equal interest and importance, a better picture of the structure of a metal surface and of the gas layers which form on it.

PSYCHOLOGY'S FAMILY RELATIONS AMONG THE SCIENCES[1]

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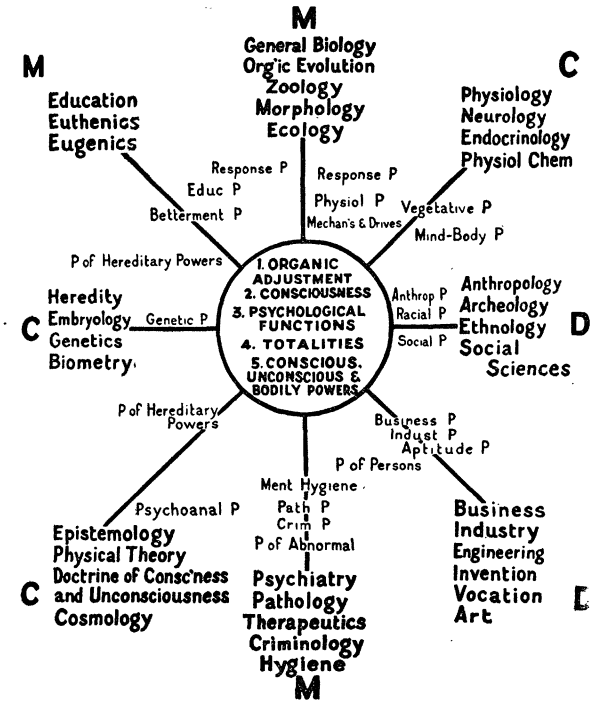
SCIENCES, like families, have their lines of descent. In some the ancestral strains are easily to be traced; in others the derivation is clouded by uncertainty or complicated by strange infusions. Some of the older sciences derive with great directness and simplicity from remote cosmogonies and philosophies; but the younger members often branch widely in process of generation, going back to disparate sources and interlacing with many other lines. For the contrast you have only to compare chemistry and biochemistry, physics and endocrinology.

Like the average family, again, the science possesses a large number of collateral relations. It has its brethren in other sciences, its cousins and nephews among the professions, and numerous legal kin acquired by solemn union with the arts and vocations. No occasion in the year so inevitably brings out these collateral relations as does the great winter pilgrimage of our tribes of the Triple-A to the common Mecca of the Faithful. Here we find many evidences of our familial ties and of our close fraternal dependencies; our intersectional interests, our passionate allegiance to the virginal mother, our implicit trust in the beneficent guidance of the Council of the Elders, our frigid intersectional shuttling from door to door in wintry blasts, our hybrid conferences, and our embracing symposia.

[1] Address of the retiring vice-president and chairman of Section I—Psychology, American Association for the Advancement of Science, Cleveland, January 2, 1931.

But the individual subject may itself be aptly used to exemplify the same sort of horizontal membering. Take psychology. It is not easy to enclose within a single central area all that is named by that name. And when we look beyond the more immediate boundaries, we observe a large number of widely radiating lines leading first toward a number of psychological specialties and ultimately to other collateral subjects each with its own family seat but each maintaining an intimate relation with psychology. These lines run outward from our own central domain toward general biology, zoology and ecology; toward physiology, neurology and endocrinology; toward anthropology, ethnology and sociology; toward business, vocation and industry; toward medicine, criminology and hygiene; toward physical and cosmological theories and doctrines of mind and matter; toward heredity, embryology and genetics; and, finally (if the long list may be completed), to education and human betterment. Add a multitude of cross-threads running helter-skelter throughout the figure and you have a gross representation of the great psychological family as it greets the New Year of 1931.

Now it is necessary that the inner circle of psychology be drawn wide enough to make room upon its convexity for all these centrifugal connections. But it is obvious upon inspection that the wide diameter has not been arbitrarily chosen. It has of necessity to embrace the existing schools and basal varieties.



These latter are many because of the wide range of outside interests, and the outside interests are multiform because psychologists variously envisage and variously develop their own subject. These two geometrical aspects are, then, wholly correlative, and they are derived from one and the same historical setting. For three decades at least psychologists have been reaching out to touch knowledge, the arts, the professions, and the affairs of every-day living. And at the same time all these human interests have been pressing in upon psychology, implicitly confessing that man's learning and man's living require facts and principles not otherwise supplied in the curriculum of the sciences.

Let it be observed that, in spite of this entanglement in the collateral lines, our outside connections, while many, are not wholly disordered. We count our brethren among the biologists, the neurologists and the students of early man; our cousins among the biometrists, therapeutists and promoters of hygiene; and our more distant relatives-by-adoption among such diverse strains of kinship as the historians of the law and of custom, the acoustical and optical engineers, personnel researchers and physicists speculating upon the nature of the cosmos.

Again, these connections imply certain distinctive attitudes assumed by our brethren toward their younger, psychological sibling. The first of these attitudes is one of active solicitude and suggestion. It has been conspicuous in three quarters, general biology, education and medicine. All three brethren have shown a willingness to conduct and to care for the affairs of psychology. Let us call these the *managing* relatives (M). So deeply have they set their mark that many observers have, in passing by, regarded psychology as a mere branch of biology, a mere convenience of education, or a mere application of medicine to mind. Three other consociated groups are *contributing* relatives (C). Present psychology would not be possible without the contributions generously made to it by physiology, bodily history and reflective theory. Every one who deals broadly with the living organism must know the body's functional devices and the body's mode of derivation and development. For general theory and speculative assumptions the empirical sciences have less use, and psychology can well afford to reduce still further her family intimacies in that direction; but as matters stand to-day that source of contributions can not be ignored. The chief *dependent* relatives (D) are two: the one the group of social studies and the other the practical and technical group at the southeast corner of the figure; the one depending upon psychology for a depiction of the socialized organism at work and the other for methods and means of estimating and measuring human differences in production and accomplishment.

Neither are we wanting in those more intimate and irregular relations which sometimes threaten to disrupt the smooth convexity of the family circle. The union of psychology and anthropology was formally recognized in our companionate Section H, but later dissolved by a decree of our discrete Council of Elders, restoring to both parties their singular freedoms. The case was not complicated by offspring; but fruitful relations have since been resumed between anthropology and psychology, and a whole chain of A and P trading-posts has now sprung up, the most conspicuous among them all to be found in our Division of the National Research Council. The fact that one individual—be he A or P—is now annually selected to nourish this bilingual offspring would seem to provide a practical sanction for such informal conditions of hybrid union.

We have also our frank illegitimacies, as certain irreconcilable behaviorists once disclosed. Apparently bred from biology, but eager to claim another birthright and bold to adopt another family name, the behavioristic pretender threatened to crowd all other fledglings from the nest. Fortunately the nest was widened by the aggressive intruder and his behavior has been gradually improved by more disciplined mates. The reformation is now cited to establish the conquest of hereditary taint and to prove that, no

matter how bad the egg, a good environment may suffice to make a decent bird.

Among those orphaned offspring of strange alliances which have been adopted by psychology stand that issue of metaphysics and medicine which still answers at times to the name of Freud and that other issue of epistemology and sociology which came to us under the alias of *Phänomenologie* and now proposes to prefix the Christian name "Social" to our family title.

The inseminating powers of the word in creating new members of a family group are well illustrated by anthroponomy and functionalism, and by a whole group of qualifiers which includes hormic, dynamic, reflexological, individual and biosocial.

Had ever a sober discipline so many relatives and so thorny a family tree? Or is psychology not sober? And does "discipline" less name her than name her needs? Have loose company and tight companions given her landscape an apparent rotatory blur? Is it all a temporary amblyopia? Or is her difficulty fixed in the genes and so predestined to disfigure her progeny?

Soon psychology must seriously consider the f_1 generation. With so many present alliances, exogamous and incestuous, and so many legal and irregular adoptions into family intimacy, provision against the future will presently become urgent. Naming the offspring will itself prove to be a task. There will be the little son who experts for the automobile-assembling crew, and others who control the efficient pasting of bottle labels and the making of soups. Wall-Street psychologists are coming on in litters, and so are the precocious advertising prophets, psycho-physicians to domestic disharmony, experts attached to football coaches, vocational horoscopists in nursery schools, and many other specialists. Each little psychologist must have his proper Christian name lest he develop an inferiority during his impressionable years.

But all that anxiety about the new brood may be left to the future. Sufficient unto the day. . . . Nor should we be disturbed by a recent rumor, imported from abroad, that psychology is a "curse." Our multiplicity of kinds and of tasks may have suggested to the uninformed that we are muddled or futile; but only a comedian designing a travesty or a zealot kindled by emotion would travel overseas to persuade the intelligent that psychology possesses the blighting power of the witch. Possibly we shall find that the query has mistaken psychology for some temporary cult current in another land or that it is only a jest turned to account for the pockets of clever debaters.

Our immediate concern is for

> The worried old lady, at sea in the blue,
> Who has so many collaterals
> She doesn't know what to do.

Some of our stricter monogamists offer simple remedies. "Connect sense organ and muscle," says one, "and christen them the Reflex Couple." "Body and mind," declares a second, "were eternally conjoined. Let no pagan put them asunder." "On the contrary," counsels a third, "divorce them, annihilate mind, and set a strict watch upon the future behavior of the liberated body." "If you will but give Psyche new glands," cries the plastic surgeon, "a new libido will appear and will instinctively select a proper mate." "Bring her to church with anthropology, with ethnology, education, sociology, medicine, hygiene," shouts the crowd of self-appointed advisers, "and have her respectably and usefully conjugated."

Now it is an astonishing fact that all this gratuitous advice has actually been offered and, in certain quarters, actually accepted. You have only to examine the writings of the psychological family during the past year to discover that each of these ligations has somewhere been assumed and turned to account. The result is striking. A large part of the literary product of the year and of other recent years lies in the great intermediate region bordering upon the periphery of our figure. So much, in fact, is in the periphery that it sometimes appears that psychology is chiefly a medley of interests and relations, without independent status, extending freely from biology on the one side to medicine on the other, from neurology to neurotics, from heredity to eugenics, and from instincts to social institutions, with only a colored vacuum to mark the central nexus of cross-reference. If we are not such a medley, it may be worth our while to encourage the accumulation of substance in the colored vacuum and thereby to consolidate our central field. It may well be doubted whether a subject which cultivates the title of science can long continue to do more than journeyman's jobs outside unless it has its own common principles and its distinctive subject-matter.

Possibly we should improve our perspective by asking as many of the relatives of psychology as bear the name of science to give us their views of our own subject. Relatives are notoriously frank and plain of speech. If we did, however, we should not find it easy to ignore the non-scientific members of the family group; education, medical arts, eugenics, human betterment, social and industrial practice, and the vocations. The heavy dependence of psychology upon these is readily to be seen when they are removed from the field. Psychology as it is now professed would certainly change its perspective without

their support. But the appropriate inquiry of the hour more specifically concerns the sciences. To these we must briefly turn.

At once we discover that the reference inward toward psychology from any one of the outlying sciences is generally toward some one particular variety, and not to the subject at large. Thus the group at the top, the biological group, stands related to that form or variety of psychology indicated by organic adjustment. For this there are two reasons. The first is that the fundamental doctrine of adjustment falls under biological theory. The second is that the emphasis here placed upon animal behavior is an ecological offshoot of zoology. It is chiefly among psychologists of this temper that the management and exploitation of their field by the biologists has been condoned. In a similar way, the lower center (conscious, unconscious and bodily powers) has been primarily directed and exploited by the medical cousins, uncles and aunts, with an added doctrinal importation from the speculative group in the extreme southwest. It is obvious, moreover, that the psychologists of consciousness and totality have also received large gifts from doctrinal and theoretical sources. At the same time, both these latter psychologies tend now to be more and more independent of these elder relatives and therefore more and more genuinely psychological.

It is interesting to observe that the hereditary group at the left has contributed to every central phase of psychology. Organic adjustment draws thence a genetic account in its own biological terms; consciousness sees itself individually developing upon a native organic base; the psychological functions imply stock as an enduring factor operative throughout life; totalities refer backward to primitive structures of figure-and-ground demanding bodily heritage and development; and the forces put to psychoanalytic uses imply both a bodily heritage and either an organic or a mental unfoldment. In a word, no general psychology has yet succeeded in our times without laying a basis in heredity and organic development.

On the side of the dependent relatives, it is clear that the backward reference toward psychology has usually been made toward a single central type. Thus the business group has usually drawn upon the doctrine of organic adjustment; though its methods have commonly come through the minor eccentric groups of educational psychology and the psychology of hereditary powers, thus deriving ultimately from tests and the statistical schools of biometry and genetics. Its debt is primarily to education and the biological sciences, however much it has received gifts at second-hand through these intermediating tradesmen. It has been only slightly tinctured by the central principles, facts and methods of psychology.

The anthropological and social dependence is more varied and more ambiguous. That large group comes groping to psychology not quite knowing what it wants in that direction and still less clear as to what it can get. Both uncertainties may very well indicate that the psychologies of the present are not prepared to serve the social studies. Sociology has had to be satisfied with its half-breed cousin christened social psychology and by an adoption of psychology's borrowed phrases about heredity and environment, instincts and dispositions, group-behavior and implicit responses. Cultural anthropology draws more variously, seeking with greater precision for psychological factors and causes to clarify the origin and the significance of its cultural products, *i.e.*, language, custom, ceremonial, manufacture, and the rest. Here is a legitimate want which psychology might well seek to satisfy by first acquiring a more empirical view of human socialization and then testing its view by an examination of those processes and resources by which man has produced the cultural objects. Until now she has created no body of fact and doctrine which is adequate to the great demands of cultural anthropology. Physical anthropology is still untouched by its psychological relations, and the anthropologist of human beginnings has been too closely engaged with the geologist and the comparative anatomist to trouble himself with psychological vagaries suggested by the naked fragments which he has turned up in cave and gravel wash. Finally, the anthropologists of the Galtonian type have, in their inquiries into human faculty, contented themselves with methods more biometric and educational than psychological, though sometimes couched in terms of the psychological functions.

The special and partial psychologies which lie scattered about the face of our figure are curious members of our large family. They must be counted with the f_1 progeny, for they derive, each and all, from a cross between the central member and a non-psychological parent. Do you not agree that they all stand, in point of resemblance, nearer the peripheral sire; educational psychology nearer education, social nearer the social sciences, psychoanalytic nearer medicine and metaphysics, vegetative nearer neurology, physiological nearer physiology, and the various psychologies of personality nearer the gross arts of every-day living? The prepotency of the non-psychological parent seems to me to be evident in their manner of operation and in their results, a fact which may be used to suggest a very important commentary upon the existing state of psychology, which has acquired

the knack of reflecting, as it moves, the variegated coloring of its surroundings. Psychology comes near to being all things to all environing sciences and to all human arts. Its services are too much those of a jack-of-all-trades, who has many facilities but no profession.

That is our state; but fortunately it is not our tendency. Our subject lacks central cohesion and organization. Its representative schools are too many and too various. They have had of late but meager means of exchange and few common interests and goals. That is the inevitable result of the last quarter of a century in the study of life and society and in business and industry. But I think that the state is changing. Signs of integration are not wanting. No one of our five centers in the figure is so impervious and so self-contained as it was ten years ago. Their dialects are acquiring more and more common terms and phrases. There is more tolerance and more give-and-take. More researches pass current in all centers. It appears that the processes of fusion and consolidation are waxing, and that, on the other side, psychology is tending away from the encompassing disciplines and interests. The time may therefore come when it will not be chiefly a minor branch of biology, a medical clinic for the disordered and the introverted, a testing room for education and the juvenile court, a meeting place for neurological vagaries, a cataloguer of social epithets, a diviner of vocations, and a fad of the curious. Diversity of tasks and multiplicity of interests are impressive signs of life and energy; but they do not take the place of central principles, common hypotheses and attested methods of research, all indications of sanity which can not safely be replaced by a common name, registration in a common directory, and adherence to a common section in the associated sciences. As psychology values more and more its independence, husbands more and more its unique resources, and clarifies more and more its proper relations among the sciences, it will, as I believe, deal more frankly and competently with certain functions and performances of the living organism which at present fall to the lot of no distinctive member of the whole large family of the sciences.

OBITUARY

MEMORIALS

THE late Dr. Bashford Dean, founder of the Department of Fishes in the American Museum of Natural History, and at the time of his death in December, 1928, honorary curator of ichthyology, left behind him a number of sets of magnificent unpublished drawings illustrating the embryology of three of the lowest fishes. His materials and drawings are being worked up by certain of his associates and former students, and the resulting papers will be published by the museum in parts as finished as "The Bashford Dean Memorial Volume—Archaic Fishes" in quarto size under the editorship of Dr. Eugene W. Gudger, bibliographer and associate in ichthyology. The first article, a "Memorial Sketch" by Dr. William K. Gregory, a former student of Dr. Dean and his successor as curator of ichthyology, was published on December 15. It consists of a twenty-two page sketch of Dr. Dean's life and work, divided into sections to show on what subjects he was working at various times. This is illustrated by a photograph and five half-tone portraits. Next there is a complete bibliography of Dr. Dean's writings comprising 315 titles. At the end are appendices containing lists of other memorial sketches, copies of resolutions and memorial minutes adopted by various organizations, and reports of the opening of memorial and research rooms and exhibits dedicated to Dr. Dean in both the Metropolitan Museum of Art and the American Museum of Natural History. This is illustrated by photographs of the memorial tablets in the two museums and by two other figures. This Article I of the Memorial Volume comprises forty-two pages, and has eight plates and two text-figures.

IN memory of Dr. William Diller Matthew, professor of paleontology, who died at the University of California on September 24, members of the faculty have arranged to give a series of seminars or discussions on paleogeography this spring, starting on January 21.

The first seminar will be led by Dr. Charles L. Camp, curator of reptiles and amphibians, who will review Dr. Matthew's book, "Climate and Evolution." Other men who will lead seminars are: R. W. Chaney, curator of paleobotany; Dr. B. L. Clark, professor of paleontology; Assistant Professor N. E. Hinds and Professor G. D. Louderback, of the geology department; Professor C. O. Sauer and Assistant Professor J. B. Leighly, of the geography department; Professor W. A. Setchell, Professor W. L. Jepson and H. L. Mason, of the botany department; Dr. H. M. Hall, of the Carnegie Institution, Washington, D. C.; Dr. Alden Miller, zoology department; Professor E. C. Van Dyke, entomology department; Professor T. Wayland Vaughan, director of the Scripps Institution of Oceanography, and Dr. C. E. Weaver, of the University of Oregon.