light sources taken from Professor Langley's work (Fig. 4). The difficulties attendant upon the accurate determination of the curve for the fire-fly are so great that we ought not to expect very great accuracy in this case. These curves, which in each case refer to the energy after passing through glass, which cuts off energy of long wave-lengths, represent the same quantities of radiant energy. While the sun is much more efficient than the gas flame or carbon arc, it still presents far the largest part of its energy in the invisible long wave-lengths (above 0.8), while the fire-fly seems to have its radiant energy confined to a narrow part of the visible spectrum.

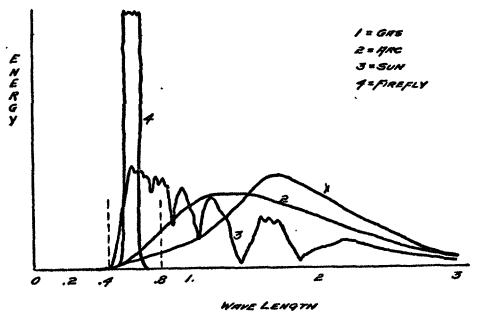

FIG. 4

W. R. WHITNEY
GENERAL ELECTRIC COMPANY,
SCHENECTADY, N. Y.

RACIAL DIFFERENCES IN MENTAL TRAITS[1]

ONE of the most agreeable and satisfying experiences afforded by intellectual pursuits comes from the discovery of a clean-cut distinction between things which are superficially much alike. The esthetic value of such distinctions may even outweigh their intellectual value and lead to sharp lines and antitheses where the only difference that exists is one of degree. A favorite opportunity for this form of intellectual exercise and indulgence is afforded by the observation of groups of men. The *type* of man composing each group—that is what we should like to find; and we hear much of the "typical" scientist, the typical business man, the typical Englishman or Frenchman, the typical southerner, the typical Bostonian. The type of any group stands as a sort of ideal within the group, and, more or less caricatured, as the butt of the wit of other groups. There is one peculiar fact about these types: you may have to search long for an individual who can be taken as a fair example. And when you have at last found the typical individual, you may be led to ask by what right he stands as the type of the group, if he is a rarity amidst it.

If we would scientifically determine the facts regarding a group of men, we should, no doubt, proceed to examine all the individuals in the group, or at least a fair and honest representation of them. The first fact that meets us when we proceed in this way is that the individuals differ from each other, so that no one can really be selected as representing the whole number. We do find, indeed, when we measure the stature or any other bodily fact, or when we test any native mental capacity, that the members of a natural group are disposed about an average, many of them lying near the average, and few lying far above or far below it; and we thus have the average as a scientific fact regarding the group. But the average does not generally coincide with the type, as previously conceived, nor do the averages of different groups differ so much as the so-called types differ. Moreover, the average is itself very inadequate, since it does not indicate the amount of variation that exists within the group—

[1] Address of the vice-president and chairman of Section H—Anthropology and Psychology—of the American Association for the Advancement of Science, Boston, 1909.

and this is one of the most important facts to be borne in mind in understanding any collection of individuals. It is specially important in comparing different groups of men, since the range of variation within either group is usually much greater than the difference between the averages of the groups. The groups overlap to such an extent that the majority of the individuals composing either group might perfectly well belong to the other.

No doubt statements like this will be readily accepted as far as concerns the different nations belonging to the same race. One could not seriously doubt that the nations of Europe, though they might differ slightly on the average, would so much overlap one another that, except for language and superficial mannerisms, the great majority of the members of one nation might be exchanged with a majority from another nation without altering the characteristics of either. But when we extend our view to all the peoples of the earth, the case would at first appear quite changed. Certainly whites and negroes do not overlap, to any extent, in color of skin, nor negroes and Chinamen in kinkiness of hair, nor Indians and Pygmies in stature. Such specialization of traits is, however, the exception. Whites and negroes, though differing markedly in complexion and hair, overlap very extensively in almost every other trait, as, for example, in stature. Even in brain weight, which would seem a trait of great importance in relation to intelligence and civilization, the overlapping is much more impressive than the difference; since while the brain of negroes averages perhaps two ounces lighter than the brain of Europeans, the range of variation within either race amounts to 25 ounces.

Our inveterate love for types and sharp distinctions is apt to stay with us even after we have become scientific, and vitiate our use of statistics to such an extent that the average becomes a stumbling-block rather than an aid to knowledge. We desire, for example, to compare the brain weights of whites and of negroes. We weigh the brains of a sufficient number of each race —or let us at least assume the number to be sufficient. When our measurements are all obtained and spread before us, they convey to the unaided eye no clear idea of a racial difference, so much do they overlap. If they should become jumbled together, we should never be able to separate the negroes from the whites by aid of brain weight. But now we cast up the average of each group, and find them to differ; and though the difference is small, we straightway seize on it as the important result, and announce that the negro has a smaller brain than the white. We go a step further, and class the white as a large-brained race, the negro as a small-brained. Such transforming of differences of degree into differences of kind, and making antitheses between overlapping groups, partakes not a little of the ludicrous.

We seem to be confronted by a dilemma; for the group as a whole is too unwieldy to grasp, while the average, though convenient, is treacherous. What we should like is some picture or measure of the *distribution* of a given trait throughout the members of a group; and, fortunately, such measures and pictures can be had. Convenient and compact measures of variability are afforded by the science of statistics, and are of no less importance than the average. But still better, because closer to the actual facts, are graphic or tabular pictures of the distribution of the trait, showing the frequency with which it occurs in each degree. The distribution of a trait is for some purposes more important than the average. Let us suppose, for instance,

that two groups were the same in their average mental ability, but that one group showed little variation, all of its members being much alike and of nearly the average intelligence, while the other group showed great variability, ranging between the extremes of idiocy and genius. It is evident that the two groups, though equal on the average, would be very unequal in dealing with a situation which demanded great mental ability. One master mind could supply ideas for the guidance of the group, and his value would far outweigh the load of simpletons which the group must carry.

If groups of men differ in average intelligence, this difference would have an influence on their effectiveness in mental work, and so, no doubt, on their advance in civilization. If groups differ in variability, this would probably have a still greater influence. There is one respect in which groups certainly do differ. They differ in size, and size is an important consideration, even from a purely biological point of view. The more numerous the individuals born into a group, the greater the absolute number of gifted individuals to be expected; and in some respects it is the absolute rather than the relative number of able men that counts. Besides this, the larger the group, the greater the chance of its producing a truly effective genius, just as, in the experiments of Burbank and other breeders, a vast number of plants are grown, in order to increase the chance of sports occurring.

One further consideration of this partly biological, partly statistical, nature should be brought forward before passing from preliminary remarks to the consideration of actual data. When the individuals composing a group are measured or tested in several traits, it is found that those who rank high in one trait do not always rank high in others. On the whole, there is more correspondence than opposition; an individual who ranks well in one trait is rather apt to rank well in others. The correlation, as we say, is positive, but it is far from perfect. The individuals most gifted with ability in war are not altogether the same individuals who are ablest in government, or in art or literature, or in mechanical invention. This fact is not only of importance in reaching a just conception of a group, but it should be considered in comparing different groups. The circumstances surrounding a group call for certain special abilities, and bring to the fore the individuals possessing these abilities, leaving in comparative obscurity those gifted in other directions. Judging the group largely by its prominent individuals, we get the impression that the group is gifted in certain lines, and deficient in others. A nation whose circumstances call for industrial expansion and the exploitation of natural resources gives prominence to those of its members who are successful in these pursuits, and leaves in obscurity many who have native capacity for military leadership. Should war come to such a community, time and bitter experience are often necessary before the leadership can be transferred from the previously eminent men to those obscure and often despised individuals who are capable of doing best service in the new direction. This lack of perfect correlation between various abilities makes it difficult to judge of the capacity of a group of men by casual observation; and we must accordingly discount largely the appearance of specialization of mental traits in different peoples.

All in all, the discovery of true inherent differences between races and peoples is an intricate task, and if we now turn to the psychologist to conduct an examination of different groups, and to inform us regarding their mental differences, we must not

allow him to present a hasty conclusion. His tests must be varied and thorough before we can accept his results as a serious contribution to this difficult subject. The psychologist may as well admit at once that he has little to offer; for, though the "psychology of peoples" has become a familiar phrase, and though books have been written on the subject, actual experimental work has so far been very limited in quantity.

One thing the psychologist can assert with no fear of error. Starting from the various mental processes which are recognized in his text-books, he can assert that each of these processes is within the capabilities of every group of mankind. All have the same senses, the same instincts and emotions. All can remember the past, and imagine objects not present to sense. All discriminate, compare, reason and invent. In all, one impulse can inhibit another, and a distant end can be pursued to the neglect of present incitations. Statements to the contrary, denying to the savage powers of reasoning, or abstraction, or inhibition, or foresight, can be dismissed at once. If the savage differs in these respects from the civilized man, the difference is one of degree, and consistent with considerable overlapping of savage and civilized individuals. The difference of degree calls for quantitative tests. But besides the traditional classification of mental powers, there is another of perhaps greater importance in studying differences between men. One individual differs from another not so much in power of memory, or of reasoning, or of attention, or of will, as in the sort of material to which he successfully applies these processes. One gives his attention readily to mathematics; he remembers mathematics easily; he reasons well on mathematical subjects; his will is strong in excluding distracting impulses when he is in pursuit of a mathematical goal. He may show none of these powers, in a high degree, in relation to music, or business, or social life; whereas another, totally inefficient in mathematics, may show equal powers of mind in another subject. The capacity to handle a given sort of subject matter is in part determined by native endowment, but is very responsive to training, and therefore is hard to test, because only individuals with equal training in any subject can be fairly tested and compared as to their native capacity to handle that subject. Thus it becomes hard to contrive a test for musical or mathematical or mechanical endowment which could fairly be applied to races having diverse trainings in these lines. This difficulty, moreover, infects our tests for such general powers as memory or reasoning, for a test has to deal with some sort of material, and success in passing the test depends on the familiarity of the material as well as on the power of mind which we design to test. We may suppose, indeed, that all of our tests, founded as they are on material which is familiar to us, will be more or less unfair to peoples of very different cultures and modes of life. The results of our tests need to be discounted somewhat—exactly how much we can not say—in favor of the primitive peoples tested.

We are now, it would seem, sufficiently entrenched in precautions and criticisms to admit the psychologist to our councils, and hear the results of his tests.

First, as to the senses. The point of special interest here is as to whether the statements of many travelers, ascribing to the "savage" extraordinary powers of vision, hearing and smell, can be substantiated by exact tests. The common opinion, based on such reports, is, or has been, that savages are gifted with sensory powers quite beyond anything of which the European is capable; though Spencer explains

that this is a cause of inferiority rather than the reverse, because the savage is thus led to rely wholly on his keen senses, and to devote his whole attention to sense impressions, to the neglect and atrophy of his intellectual powers. Ranke, however, on testing natives of Brazil, a race notable for its feats of vision, found that their ability to discern the position of a letter or similar character at a distance, though good, was not remarkable, but fell within the range of European powers. The steppe-dwelling Kalmuks, also renowned for distant vision, being able to detect the dust of a herd of cattle at a greater distance with the naked eye than a European could with a telescope, have also been examined; and their acuity was indeed found to be very high, averaging considerably above that of Europeans; yet only one or two out of the forty individuals tested exceeded the European record, while the great majority fell within the range of good European eyes. Much the same result has been obtained from Arabs, Egyptians and quite a variety of peoples. Among the most reliable results are those of Rivers on a wholly unselected Papuan population. He found no very exceptional individual among 115 tested, yet the average was somewhat better than that of Europeans. I had myself, through the kindness of Dr. McGee, the opportunity of testing individuals from quite a variety of races at the St. Louis Fair in 1904, and my results agree closely with those already cited, though I did not find any cases of very exceptional powers among about 300 individuals. There were a number who exceeded the best of the 200 whites whom I also tested under the same conditions, but none who exceeded or equaled the record of a few individuals who have been found in the German army. Indians and Filipinos ranked highest, averaging about 10 per cent. better than whites, when all individuals of really defective vision were excluded. The amount of overlapping is indicated by stating that 65–75 per cent. of Indians and Filipinos exceeded the average for whites. It did not seem possible, however, to assert anything like a correspondence between eyesight and the degree of primitiveness or backwardness of a people; since, for instance, the Negritos of the Philippine Islands, though much more primitive than the Malayan Filipinos in their mode of life, and, indeed, the most primitive group so far tested, were inferior to the Filipinos, and, in fact, as far as could be judged from the small number examined, no whit superior to whites. Nor does it seem possible, from results hitherto reported, to believe in a close correspondence between keen sight and dark skin, though it is true that pigment is important in several ways to the eye, and that therefore, as Rivers has suggested, the amount of pigmentation might be a factor in vision. But it does not seem to be specially the darkest races that show the keenest vision. We may perhaps conclude that eyesight is a function which varies somewhat in efficiency with difference of race, though with much overlapping. No doubt, however, the results as they stand need some qualification. On the one hand, inclusion of individuals with myopia and similar defects would lower the average of Europeans considerably more than that of most other races; so that the actual condition of eyesight differs more than the results show. On the other hand, it would not be fair to include near-sighted individuals, if what we wish to discover is native differences between peoples; for the different prevalence of myopia is certainly due to the differing uses to which the eye is put. And this matter of use may have considerable influence on the individuals not classed as near-sighted, and so admitted to the comparison.

Rivers has made an observation in connection with the test for eyesight, which I am able to confirm, and which is perhaps of much importance. He found that when the letter or character used in his test, the position of which had to be recognized at the greatest possible distance, was removed from him beyond the distance at which he felt that he could judge it, he could still guess it right nearly every time, though without confidence. By such guessing, one's record in this test can be bettered considerably; and careful study enables one to see the slight and blurred indications of position which form the basis of the guessing. Now it may well be that the occupations of civilized life breed a habit of dependence on clear vision, whereas the life of those who must frequently recognize objects at a great distance breeds reliance on slight indications, and so creates a favorable attitude for the test of eyesight. When this possibility is taken in connection with the deterioration of many European eyes from abuse, and in connection with the observed overlapping of all groups tested, the conclusion is not improbable that, after all, the races are essentially equal in keenness of vision. Even if small differences do exist, it is fairly certain that the wonderful feats of distant vision ascribed to savages are due to practise in interpreting slight indications of familiar objects. Both Rivers and Ranke, on testing some of the very individuals whose feats of keen sight seemed almost miraculous, found that, as tested, they had excellent but not extraordinary vision. A little acquaintance with sailors on shipboard is enough to dispel the illusion that such feats are beyond the powers of the white man.

The hearing of savages enjoys a reputation, among travelers, similar to that of their sight; but there can be little doubt that the cause is the same. In fact, the tests which have so far been made tend to show that the hearing of whites is superior. Such was the result of Myers on the Papuans, and of Bruner in his extensive series of measurements made at the St. Louis Fair. Only 15 per cent. of 137 Filipinos tested did as well as the average of whites; other groups made a somewhat better showing, but all seemed inferior on the average to whites. In spite of the experimental results, there is perhaps reason to doubt that the hearing of whites is essentially and natively much superior to that of other races. Civilized life protects the ear from some forms of injury to which it is exposed in more primitive conditions; and, then, the question of cleanliness must be considered in regard to the meatus. Besides, the ear is known to be highly susceptible of training in the perception of particular sorts of sound—as overtones and difference tones—and it is likely enough that the watch ticks and similar clicks used in the tests are not equally within the repertory of all peoples.

Much the same can be said regarding keenness of smell. On account of the high olfactory powers of dogs and some other lower animals, it has often seemed natural and proper that this sense should be highly developed among savages; and feats of primitive folk have been reported quite analogous to those already referred to under sight and hearing. No doubt here again, special interests and training are responsible, since what few tests have been made tend to show no higher acuity of smell among negroes and Papuans than among Europeans.

The sense of touch has been little examined. McDougall found among the Papuans a number with extremely fine powers of discrimination by the skin. The difference between two points and one could be told by these individuals even when the

two points were brought very close together; on the average, the Papuans tested excelled Europeans considerably in this test. On the other hand, Indians and Filipinos, and a few Africans and Ainu, tested in the same manner, seem not to differ perceptibly from whites.

The pain sense is a matter of some interest, because of the fortitude or stolidity displayed by some races towards physical suffering. It may be, and has been conjectured, that the sense for pain is blunt in these races, as it is known to be in some individuals who have allowed themselves to be burned without flinching, and performed other feats of fortitude. The pain sense is tested by applying gradually increasing pressure to some portion of the skin, and requiring the person tested to indicate when he first begins to feel pain. Now, as a matter of fact, the results of McDougall on the Papuans, and those of Dr. Bruner and myself on Indians, Filipinos, Africans and Ainu, are in close agreement on this point. Greater pressure on the skin is needed to produce pain in each of these races than in whites. This is the average result, but in this test the distribution of the cases is specially important. Though most whites feel pain at or about a certain small pressure, there is quite a respectable minority who give no sign till much higher pressures are reached, their results corresponding very closely to those of the majority of Indians. And similarly, a minority of Indians feel pain at much lower pressures than the bulk of their fellows, falling into the ranks of the white man. In each group, the distribution is bimodal, or aggregated about two points instead of one; but whites are principally aggregated about the lower center, and Indians and other races about the higher center. Introspection comes to our aid in explaining this anomaly, for it shows that there is some difficulty in telling just when the pressure becomes painful. If one is satisfied with slight discomfort, a moderate pressure will be enough; but if a sharp twinge is demanded, the pressure must be considerably increased. Most whites, under the conditions of the test, are satisfied with slight discomfort, while my impression in watching the Indians was that they were waiting to be really hurt. The racial difference would accordingly be one in the conception of pain, or in understanding the test, rather than in the pain sense.

On the whole, the keenness of the senses seems to be about on a par in the various races of mankind. Differences exist among the members of any race, and it is not improbable that differences exist between the averages of certain groups, especially when these are small, isolated and much inbred. Rivers has in fact found such small groups differing considerably from whites in the color sense. One such group showed no cases of our common color blindness or red-green blindness, while another group showed an unusually large percentage of color-blind individuals. In the larger groups, the percentage of the color-blind is, very likely, about constant, though the existing records tend to show a somewhat lower proportion among Mongolians than among whites. Very large numbers of individuals need, however, to be tested in order to determine such a proportion closely; even among Europeans, the proportion can not yet be regarded as finally established. One thing is definitely shown by the tests that have been made for color blindness in various races: no race, however primitive, has been discovered in which red-green blindness was the universal or general condition; and this is a fact of some interest in connection with the physiology of color vision, for it seems probable that red-green blindness, since it

is not by any means a diseased condition, represents a reversion to a more primitive state of the color sense. If this is so, no race of men remains in the primitive stages of the evolution of the color sense; the development of a color sense substantially to the condition in which we have it, was probably a pre-human achievement.

In the actual history of the discussion of the color sense in various races, quite a different view of the evolution has been prominent. It was Gladstone who first, as an enthusiastic student of Homer, was struck by the poverty of color names in ancient literature, and who suggested that the Greeks of the Homeric age had a very imperfectly developed eye for color. He was especially impressed by the application of the same color name to blue and to gray and dark objects. Geiger, adhering to the same sort of philological evidence, broadened its scope by pointing out the absence of a name for blue in other ancient literatures. It is indeed curious that the sky, which is mentioned hundreds of times in the Vedas and the Old Testament, is never referred to as blue. The oldest literatures show a similar absence of names for green. Geiger found that names for black, white and red were the oldest, and that names for yellow, green and blue have appeared in that order. He concluded that the history of language afforded an insight into the evolution of the color sense, and that, accordingly, the first color to be sensed was red, the others following in the same order in which they occur in the spectrum. Magnus found that many languages at the present day were in the same condition as that shown in the ancient Greek, Hebrew and Sanscrit. Very many, perhaps the majority, have no specific name for blue, and a large proportion have none also for green. A smaller number are without a name for yellow, while nearly all have a name for red. It seemed that the backward races of to-day had just reached the stage, in the matter of color sensation, which was attained by other races some thousands of years ago. The underlying assumptions of this argument are interesting—the notion that the list of sensations experienced by a people must find expression in its vocabulary; and the conception of certain peoples now living as really primitive. Fortunately, Magnus submitted this theory to the test of facts, by supplying travelers and traders with sets of colors, by which various peoples were tested, first, as to their ability to name the colors in their own languages, and second, as to their power to recognize and distinguish the colors. The results of this inquiry were that names were often lacking for blue and green, but that every people was able to perceive the whole gamut of colors known to the European. This was a severe blow alike to the philological line of argument and to the ready assumption that early stages of evolution were to be found represented in the backward peoples of to-day. Accepting the facts as they stood, Magnus still felt that there must be some physiological or sensory reason for the curious lack of certain color names in many languages; and he therefore suggested that blue and green might be less vividly presented by the senses of many tribes, and that, being duller to their eyes than to Europeans, these colors did not win their way into the language. The theory was, however, practically defunct for many years till Rivers recently took it up, as the result of tests on several dark-skinned peoples. His test called for the detection of very faint tints of the various colors, and the result was that, as compared with twoscore educated English whom he also tested, these peoples were somewhat deficient in the detection of faint tints of blue—and also of yellow—but

not of red. One group, indeed, was superior to the English in red. The results made it seem probable to Rivers that blue was indeed a somewhat less vivid color to dark-skinned races than to Europeans, and he suggested that pigmentation, rather than primitiveness, might be the important factor in producing this difference. A blue-absorbing pigment is always present in the retina, and the amount of it might very well be greater in generally pigmented races. The suggestion is worth putting to a further test; but, meanwhile, the difference obtained by Rivers in sensitiveness to blue needs to be received with some caution, since the Europeans on whose color sense he relies for comparison were rather few in number, educated and remarkably variable among themselves. We were able, at St. Louis, to try on representatives of a number of races a difficult color matching test, so different indeed from that of Rivers that our results can not be used as a direct check on his; with the result that all other races were inferior to whites in their general success in color matching, but that no special deficiency appeared in the blues. We also could find no correlation between ill success in this test and the degree of pigmentation. On the whole, the color sense is probably very much the same all over the world.

That linguistic evidence is a very treacherous guide to the sensory powers of a people is well seen in the case of smell. Certainly many odors are vivid enough, yet we have no specific odor names. Only a psychologist would require a complete vocabulary of sensations; practical needs lead the development of language in quite other directions.

When we turn from the senses to other functions, the information which the psychologist has to offer becomes even more scanty.

Some interest attaches to tests of the speed of simple mental and motor performances, since, though the mental process is very simple, some indication may be afforded of the speed of brain action. The reaction time test has been measured on representatives of a few races, with the general result that the time consumed is about the same in widely different groups. The familiar "tapping test," which measures the rate at which the brain can at will discharge a series of impulses to the same muscle, was tried at St. Louis on a wide variety of folk, without disclosing marked differences between groups. The differences were somewhat greater when the movement, besides being rapid, had to be accurate in aim. The Eskimos excelled all others in this latter test, while the poorest record was made by the Patagonians and the Cocopa Indians—which groups were, however, represented by only a few individuals. The Filipinos, who were very fully represented, seemed undeniably superior to whites in this test, though, of course, with plenty of overlapping.

The degree of right-handedness has been asserted to vary in different races, and the favoring of one hand has been interpreted as conducive to specialization and so to civilization. We were, however, unable to detect any marked difference in the degree of right-handedness in different races, as tested by the comparative strength, quickness or accuracy of the two hands. The Negritos, the lowest race examined, had the same degree of right-handedness as Filipinos, or Indians, or whites.

We are probably justified in inferring from the results cited that the sensory and motor processes, and the elementary brain activities, though differing in degree from one individual to another, are about the same from one race to another.

Equitable tests of the distinctly intel-

lectual processes are hard to devise, since much depends on the familiarity of the material used. Few tests of this nature have as yet been attempted on different races.

There are a number of illusions and constant errors of judgment which are well-known in the psychological laboratory, and which seem to depend, not on peculiarities of the sense organs, but on quirks and twists in the process of judgment. A few of these have been made the matter of comparative tests, with the result that peoples of widely different cultures are subject to the same errors, and in about the same degree. There is an illusion which occurs when an object, which looks heavier than it is, is lifted by the hand; it then feels, not only lighter than it looks, but even lighter than it really is. The contrast between the look and the feel of the thing plays havoc with the judgment. Women are, on the average, more subject to this illusion than men. The amount of this illusion has been measured in several peoples, and found to be, with one or two exceptions, about the same in all. Certain visual illusions, in which the apparent length or direction of a line is greatly altered by the neighborhood of other lines, have similarly been found present in all races tested, and to about the same degree. As far as they go, these results tend to show that simple sorts of judgment, being subject to the same disturbances, proceed in the same manner among various peoples; so that the similarity of the races in mental processes extends at least one step beyond sensation.

The mere fact that members of the inferior races are suitable subjects for psychological tests and experiments is of some value in appraising their mentality. Rivers and his collaborators approached the natives of Torres Straits with some misgivings, fearing that they would not possess the necessary powers of sustained concentration. Elaborate introspections, indeed, they did not secure from these people, but, in any experiment that called for straightforward observation, they found them admirable subjects for the psychologist. Locating the blind spot, and other observations with indirect vision, which are usually accounted a strain on the attention, were successfully performed. If tests are put in such form as to appeal to the interests of the primitive man, he can be relied on for sustained attention. Statements sometimes met with to the effect that such and such a tribe is deficient in powers of attention, because, when the visitor began to quiz them on matters of linguistics, etc., they complained of headache and ran away, sound a bit naïve. Much the same observations could be reported by college professors, regarding the natives gathered in their class rooms.

A good test for intelligence would be much appreciated by the comparative psychologist, since, in spite of equal standing in such rudimentary matters as the senses and bodily movement, attention and the simpler sorts of judgment, it might still be that great differences in mental efficiency existed between different groups of men. Probably no single test could do justice to so complex a trait as intelligence. Two important features of intelligent action are quickness in seizing the key to a novel situation, and firmness in limiting activity to the right direction, and suppressing acts which are obviously useless for the purpose in hand. A simple test which calls for these qualities is the so-called "form test." There are a number of blocks of different shapes, and a board with holes to match the blocks. The blocks and board are placed before a person, and he is told to put the blocks in the holes in the shortest possible time. The key to the situation is here the

matching of blocks and holes by their shape; and the part of intelligence is to hold firmly to this obvious necessity, wasting no time in trying to force a round block into a square hole. The demand on intelligence certainly seems slight enough; and the test would probably not differentiate between a Newton and you or me; but it does suffice to catch the feeble-minded, the young child, or the chimpanzee, as any of these is likely to fail altogether, or at least to waste much time in random moves and vain efforts. This test was tried on representatives of several races, and considerable differences appeared. As between whites, Indians, Eskimos, Ainus, Filipinos and Singhalese, the average differences were small, and much overlapping occurred. As between these groups, however, and the Igorot and Negrito from the Philippines and a few reputed Pygmies from the Congo, the average differences were great, and the overlapping was small. Another rather similar test for intelligence, which was tried on some of these groups, gave them the same relative rank. The results of the test agreed closely with the general impression left on the minds of the experimenters by considerable association with the people tested. And, finally, the relative size of the cranium, as indicated, roughly, by the product of its three external dimensions, agreed closely in these groups with their appearance of intelligence, and with their standing in the form test. If the results could be taken at their face value, they would indicate differences of intelligence between races, giving such groups as the Pygmy and Negrito a low station as compared with most of mankind. The fairness of the test is not, however, beyond question; it may have been of a more unfamiliar sort to these wild hunting folk than to more settled groups. This crumb is, at any rate, about all the testing psychologist has yet to offer on the question of racial differences in intelligence.

In the absence of first-hand study of the mental powers of different races, folk psychology resorts to a comparison of their civilizations and achievements. This is the method by which we habitually compare the intelligence of individuals, judging capacity by performance, the tree by its fruits; and such judgments, though subject to occasional error, are probably in the main reliable. Why should we not extend the method to the comparison of groups, and say that a group possessing a high civilization has probably a high average intelligence, while a wild savage race is mentally poorly endowed? The first difficulty in employing the method is to obtain a just estimate of the cultures to be compared. First impressions regarding alien folk, derived from the reports of travelers, are usually wide of the mark. Only the patient and prolonged labors of the ethnologist can inform us as to what a tribe does and thinks; and where such studies have been made, it is found that a backward culture, such as that of the natives of Australia, has much more substance, and affords much wider scope for mental activity, than the early reports indicated.

The difficulty of inferring the mental endowment of a group from its stage of culture is well brought out by applying this method to the comparison of different epochs in the history of a nation. German culture to-day is much advanced from the days of Cæsar; shall we infer that the mental endowment of the Germans has advanced in like measure? Biologically, the interval, measured in generations, is not long, and from all biological considerations it is improbable that any advance in mental endowment has occurred. The difference in material civilization does not mean that

the German of to-day is, on the average, gifted with more native inventiveness or business ability than his ancestors sixty generations ago. The difference in the arts and sciences does not mean that the German of to-day is naturally more studious, or scientific, or musical. The more settled condition of society does not imply greater native capacity for industry or government. The disappearance of old superstitions does not imply that later generations were born without the tendencies to superstition which characterized their fathers. We are still not many generations removed from witchcraft, curses, magic and the like savage beliefs and practises, and we can not reasonably believe our recent forefathers to have been naturally more savage than we are. When, for psychological purposes, we compare the culture of Europe with that of Africa, we should not leave out of account the Children's Crusade, or the Inquisition, or the Wars of the Roses. And if we attempt to use the state of civilization as a measure of racial intelligence, we must somehow adapt the method so that it shall give the same results, whether earlier or later stages in the culture of a group be taken as the basis for study.

In reality, the civilization possessed by a generation can not be used as a measure of the intelligence of that generation any more than an individual's property can be taken as a measure of his business ability. The greatest part of the civilization of a generation is bequeathed to it, and only the increase which it produces can be laid to its credit. If we could compare the rate of progress in different groups, this might serve as a measure of intelligence; and certainly some peoples are more progressive than others. Before adopting such a test, we should understand the mechanism of progress—a matter which belongs only in part to psychology.

Progress depends first of all on human inventiveness—so much will probably be allowed. Under the head of inventions should be included, not only mechanical devices, but works of art and government, business enterprises and changes in custom, so far as any of these demand originality in their producers. Science and all increase in knowledge should also be included, since the process of discovery differs but little from the process of invention. In both the essential mental act seems to be a bringing together of things that are found apart, or a pulling apart of what occurs together. In fact, both of these processes, the combining or associating, and the analytic or discriminating, go on together, since we see something new in a thing when we are reminded by it of something else and different. There is a suggestion of the accidental in all invention, since it depends on "happening to notice something," or "happening to be reminded of something." You can not be sure that a person will make a discovery, even when you supply him with the elements which would combine to produce it. Oftentimes, in reading the history of scientific progress, one is surprised that a certain discovery was not made by some man who had apparently everything before him to lead to it. Invention is of the nature of a spontaneous variation, and this accidental character is very important in understanding the mechanism of progress.

On the other hand, since one can not be reminded of things entirely unknown, invention depends on previously acquired knowledge, and the inventiveness of an individual must take a direction prepared for him by the social group among which he lives. A large share of the inventiveness of the Australian natives seems to be

directed into the channels of magic and ceremony. The finished product of one mind's inventiveness becomes raw material for another, and invention of all sorts is distinctly a cooperative enterprise.

Invention is said to be mothered by necessity; and the proverb is no doubt true in the main, though curiosity and experimentation belong among the play instincts. But, in any case, the necessity must not be too dire, for some degree of leisure is demanded if anything novel is to be thought of, and rapid progress is only possible when individuals can be allowed to accumulate the special knowledge which may serve as the raw material for their inventive activity. Divisions of labor, guilds, universities, legislatures, investigating commissions, permanent research bureaus—each of which is, genetically, a series of inventions—are dependent for their existence on a certain degree of leisure, while they in turn provide more leisure and opportunity for further advance. They are inventions which accelerate the progress of invention. There are thus many factors besides the intellectual endowment of a generation which go to determine the progress which it shall make. The spur of necessity, the opportunity afforded by leisure, the existing stock of knowledge and inventions and the factor of apparent accident or luck have all to be considered.

A still further factor is the size of the group, which is deserving of renewed attention. Not only does a large group afford more opportunity for division of labor and special institutions for research, but the biological consideration already mentioned should be emphasized. The contributions to progress of the average man are small, the inventions of moment arising in the brains of a small fraction of the group. A large group provides a greater number of inventive minds, and it is rather the absolute number of such than their proportion to the whole population that determines the progress of invention within a group. The "group" needs to be redefined from the point of view of invention. If knowledge and inventions pass back and forth between two nations or races, the inventive minds of both are brought into cooperation, and the group is by so much enlarged. From the point of view of progress, however, the question is not simply how many inventive minds are brought into cooperation, but how free and rapid the communication is between them. At the present time, a discovery originating anywhere in Europe or its colonies is quickly known by specialists in all parts, and may promptly fructify the mind of a distant investigator, leading to a fresh advance. The invention of printing and of rapid means of communication must be credited with a large share of the rapid progress which has been made by the last few generations. Much also must be credited to the invention of steam power, which has vastly multiplied the size of the European group, in an economic sense, and set free many minds of ability for productive thinking. The very idea of the advancement of science and invention as an end to be striven for is to be classed as an invention, and a rather recent one; and it too is an accelerator.

Such considerations provide at least a partial explanation of the different rates of progress in different generations, and among different races. Whether they explain everything could perhaps only be determined by a drastic experiment, which it will do no harm to imagine, though the question will never be settled in this convincing way.

Let two or more habitats, isolated from each other and from the rest of the world, and as nearly as possible alike, be chosen,

and peopled by two equal groups of children, selected from some highly civilized nation, and so selected as to represent fairly the distribution of mental and physical traits among that nation. For every individual in the first group, let there be a practically identical individual in the second. Let these groups of children be introduced into their new homes in infancy, and, by some quasi-miraculous means, let them be all preserved to maturity, and then let them, and their descendants, be left entirely to their own devices, without fire, or a language, or other modern improvements. To watch such a spectacle from afar would be thrilling, if not too pitiful. We can readily grant that the infant communities would begin at the very zero of civilization, and that their progress, for many generations, would seem excessively slow. But the real point of the experiment is to inquire whether these two equal groups, alike in numbers, in heredity and in environment, would remain alike, and progress at equal rates. Probably they would not. We must allow for a large element of chance in the mating of males and females within each group, and consequently for changes and inequalities in the distribution and correlation of traits—changes which need not alter the average of either group. We must allow for spontaneous variation in the offspring, another accidental factor by virtue of which a really inventive and effective individual, or conjunction of such, would almost certainly arise in one group earlier than in the other, and give the advance of one group an impetus which might be felt through many generations, and carry this group far ahead of the other. And we must allow also for the accidental factor in invention. Even though the genius of one group was paired by an equal genius in the other, it is improbable that both would invent the same things. One might invent a hunting implement, and the other a fishing implement; and by this accident the direction of development might be settled for each group. If we closed the experiment after a thousand generations, we should probably find two peoples of different languages, different customs, and cultures divergent in many respects. The supposed result may be taken as an assertion of the importance of accident in determining the destiny of peoples. Obscure causes are no doubt at work beneath the accidents, but we can not trace them, nor reasonably state them in terms of racial superiority and inferiority.

It would seem that size of groups, and accidental factors, exert so much influence on the rate of advance in civilization that differences of culture could possibly be explained without supposing the mental endowments of the races to differ. Whether the existing races of men do or do not differ in such a trait as inventiveness is another and more difficult problem, the settlement of which must be left to time and educational experiments. The experiments must be continued for several generations, in order to equate social traditions. Regarding the negroes of the south, I am informed by a gentleman who has spent twenty years in educating them that a distinct advance is perceptible during this period, especially among the children of educated parents. These have more educational ambition, enter school earlier and have less to unlearn. The educational experiment, as far as it has gone, thus shows that much time will be needed before a clear result is reached.

Meanwhile it may be allowed to add one more general consideration by asking whether causes of a biological nature can be seen to be at work in human history, such as would differentiate the races intellectually, and, in particular, such as to

raise up, in some part of the world, a race superior to the stock from which it sprang.

Natural selection has been suggested as such a cause. Life in the tropics, it has been said, is too easy to demand much inventiveness or forethought, but a migration to colder regions, where the banana does not grow, would make mental activity imperative, and select those individuals who were able to respond, so producing a superior race. There is a difficulty here, since we should expect natural selection to begin by lopping off the most poorly endowed fraction of the population, with the result, finally, that the lower range of intelligence should disappear from the higher races. The lowest grade of intelligence in Europe should accordingly be higher than the lowest grade in Africa. But this is probably not the case; the range of intelligence reaches as low in one as in the other. The distributions of intelligence in the two also overlap to quite an extent. Extensive experiment has shown that Africans can maintain existence in the temperate zone.

Sexual selection, or, more properly, mating customs, furnish a more promising factor. If a tendency could be detected in any population for the most intelligent members to mate with each other, the result would be, not indeed a raising of the average intelligence, since the less intelligent would also mate with each other, but an increase of the variability, and greater chance of the birth of very superior individuals. A caste system might operate in this way, since the founders of aristocratic families probably won admission to the caste partly by virtue of intelligence, and their descendants would tend, by heredity, to exceed the average intelligence of the population. Marriage confined to the caste would thus tend to mate superior individuals with each other, and might, in the course of generations, raise the upper limit of intelligence. Customs of mating within one's rank obtain among the aristocracy and royalty of Europe, and may have been a factor in increasing the number of superior intelligences. But too much can not be attributed to this factor, since the selection has been by classes, and not by individuals. Royalty, while marrying within its rank, has not usually chosen the most gifted individual available. Its selection has been relatively inefficient from the standpoint of royal eugenics. Certainly the upper reach of European intelligence has not been the result of breeding by castes; for, though royalty has indeed produced a disproportionate number of high intelligences, equally able individuals have, as a matter of fact, risen from humble birth. Moreover, marriage in all parts of the world is largely governed by considerations of family standing and wealth, so that the same sort of influence toward variability is everywhere operative. The dead level of intelligence, which is sometimes supposed to obtain among backward races, is not borne out by psychological tests, since individual differences are abundantly found among all races, and, indeed, the variability of different groups seems, from these tests, to be about on a par.

Selection by migration is also to be considered. When individuals leave their group and go to a new country, it would seem that those who emigrate must differ, on the average, from those who remain behind. An adventurous and enterprising spirit, perhaps, would be characteristic of the emigrants, and so of the new people which they helped to form. On the other hand, the ne'er-do-well and the criminal might also be induced to emigrate. The selective influence of migration would not be all in one direction, and the net result could not easily be predicted. Since we are now witnessing, though little compre-

hending, this process of migration as it contributes to form a people of the future, information regarding the kind of selective influence exerted by migration would have a practical value. Wisdom would dictate that the nation which is in process of formation should exert some selective influence on its own account, but, from all the facts in hand, the part of wisdom would be to select the best individuals available from every source, rather than, trusting to the illusory appearance of great racial differences in mental and moral traits, to make the selection in terms of races or nations.

R. S. Woodworth
Columbia University

Scientific Notes and News

The Geological Society of London has awarded the Wollaston medal to Professor W. B. Scott, of Princeton University, "in recognition of his many valuable contributions to our knowledge concerning the mineral structure of the earth, and especially in relation to the tertiary mammalia and tertiary stratigraphical geology of North America and Patagonia."

At the recent meeting in Boston, Dr. George A. Piersol, professor of anatomy, was elected president of the American Association of Anatomists.

Drs. Charles H. Frazier, John H. Musser, David L. Edsall and A. C. Abbott have been appointed by Provost Harrison, of the University of Pennsylvania, managers of the Phipps Institute for the purpose of entering upon the construction of the new building with the money contributed by Mr. Phipps.

Mr. A. F. Woods left Washington on January 23 to take up his new duties at the University of Minnesota. On the evening of January 22 he was tendered a reception by the Bureau of Plant Industry, at which time a silver service was presented to him in commemoration of his long service in the bureau. Addresses were made by Assistant Secretary Hays, Mr. D. G. Fairchild and Dr. Erwin F. Smith.

A dinner in honor of Professor James Truman, emeritus professor in the University of Pennsylvania Dental School, was given at the Waldorf-Astoria, in New York City, on January 23.

On the occasion of the inauguration of Dr. H. H. Apple, as president of Franklin and Marshall College, on January 7, the degree of LL.D. was conferred on Dr. Edgar F. Smith, vice-provost of the University of Pennsylvania and professor of chemistry, and on Dr. J. H. Musser, professor of clinical medicine of the University of Pennsylvania.

Dr. Albert Ladenburg, professor of chemistry at Breslau, has been elected a corresponding member of the Paris Academy of Sciences.

Dr. Otto N. Witt, professor of industrial chemistry in the Berlin School of Technology, has been made an honorary member of the Royal Institution, London.

Mr. T. Case, Waynflete professor of moral and metaphysical philosophy and president of Corpus Christi College, Oxford University, has resigned his professorship.

Dr. C. O. Townsend, pathologist in charge of sugar beet investigations, Bureau of Plant Industry, has resigned from the government service. He left Washington on January 17, for Garden City, Kansas, where he has accepted a position as consulting agriculturist for a large sugar beet company.

Professor F. W. Morse, formerly chemist of the New Hampshire Experiment Station and professor of organic chemistry in the New Hampshire College, has been engaged temporarily as research chemist at the Massachusetts Agricultural Experiment Station.

The board of directors of the Metropolitan Life Insurance Company has appointed Dr. Jay Bergen Ogden, to be assistant medical director of the company.

Dr. Hans Hallier, conservator of the Royal Herbarium at Leyden, has been visiting the botanical gardens of the United States.