generally, represent a valuable chapter in the history of Scriptural exegesis. Later and more original commentators owe much to his voluminous and searching compilations. Perhaps his best known work is the *De clericorum institutione*, a complete manual based on the best authorities of the past, for the education and training of the clergy; this work was widely used for several centuries. The whole range of his wide reading and study is summed up in the most comprehensive encyclopaedia of the Middle Ages, the *De universo*, a somewhat larger treatise than the great synthesis of Isidore of Seville, after which it was patterned.

ROBERT FRANCIS SEYBOLT

Works: Rabanus' works are reprinted in *Patrologiae latinae*, ed. by J. P. Migne, vols. cvii–cxii (Paris 1864–78).

Consult: Dahl, J. C., *Leben und Schriften des Erzbischofs Rabanus Maurus von Mainz* (Fulda 1828); Spengler, T., *Leben des heiligen Rhabanus Maurus, Erzbischofs von Mainz* (Regensburg 1856); Türnau, Dietrich, *Rabanus Maurus, der Praeceptor Germaniae* (Munich 1900); Bach, J. N., *Hrabanus Maurus, der Schöpfer des deutschen Schulwesens* (Fulda 1835).

RABELAIS, FRANÇOIS (*c.* 1495–*c.* 1553), French romancer, physician and thinker. After abandoning the monastic life Rabelais, a native of Touraine, passed into the service and under the influence of the liberal minded du Bellays. Although he was concerned primarily with scientific knowledge rather than with language and philosophy, the great French realist speaks gratefully of his debt to Budé and Erasmus. As a link between mediaeval and modern literature his importance cannot be exaggerated. In addition to his enormous influence on French humorists from Molière to Anatole France as well as on foreign humorous literatures, he played an outstanding part in the general diffusion of the critical spirit which distinguishes the France of the seventeenth century from that of the sixteenth.

In the religious disputes he anticipated the *politiques* by adopting a middle course. Parting with Calvin on the question of man's innate corruption, he always claimed to be sincerely Catholic despite the Protestant tone of *Gargantua*. Yet he stoutly demanded church reform from within and attacked the idleness, ignorance and bigotry of the church and the Sorbonne with the same vigor that he manifested in excoriating contemporary superstitions, particularly divination by witches, Vergilian lots, dice and—in this respect almost unique in his generation—astrology. In educational theory he insisted that education be viewed as a preparation for life, stoutly advocated the necessity of instruction in the natural sciences and in particular was the first to insist on physical training. In political and social matters he at first expounded the Platonic conception of kingship, demanding of the ruler not only virtue and enlightenment but also familiarity with the practical needs of his land. Later he became more conservative but repeatedly deplored all wars and denounced such evils as the covetousness common to all classes, in which he saw a major cause for the corruption of law, marriage and other institutions. In the character of Bridoie he castigated legal incompetence; in the Chats fourrés ambition; in Entelechie social uselessness. On the positive side he emphasized the vital interdependence of rich and poor and insisted that privilege, "taking and receiving," should be supplanted as the guiding social principle by service, "imparting and giving." Finally, the old utopian dreamer of *Gargantua* and *Thélème* prophesied the rise of a new spirit of inquiry, inspiring the resolute exploration of truth, both absolute and scientific, and the building up of a body of real knowledge, which would condition the conduct of human affairs and exalt mankind to unimagined power.

A. F. CHAPPELL

Works: *Gargantua* and *Pantagruel* are included in the best modern edition, *Oeuvres*, ed. by Abel Lefranc and others, vols. i–v (Paris 1912–31). For detailed information concerning editions see Boulenger, Jacques, *Rabelais à travers les âges; compilation suivie d'une bibliographie sommaire* (Paris 1925).

Consult: Tilley, Arthur, *François Rabelais* (London 1907); Nock, A. J., and Wilson, C. R., *Francis Rabelais* (New York 1929); Plattard, Jean, *Vie de François Rabelais* (Paris 1928), tr. by L. P. Roche (London 1930); Chappell, A. F., *The Enigma of Rabelais* (Cambridge, Eng. 1924); Gebhart, Emile, *Rabelais, la renaissance et la réforme* (Paris 1877); Gmelin, Hermann, "Rabelais und die Natur" in *Archiv für Kulturgeschichte*, vol. xxiv (1933) 71–89; Compayré, G., *Histoire de la pédagogie* (Paris 1884), tr. by W. H. Payne (Boston 1885) ch. v. See also articles in *Revue des études rabelaisiennes*, published quarterly in Paris from 1903–12 and continued as *Revue du seizième siècle*, 1913–31.

RACE. The term race is often used loosely to indicate groups of men differing in appearance, language or culture. As here understood it applies solely to the biological grouping of human types. On account of the lack of sharp lines of demarcation the attempts at classification, based on varying characteristics, have not

led to a generally accepted system. Early attempts at a systematic arrangement of human races were made in the eighteenth century. Linnaeus included under the general order of primates the genus *homo sapiens*, which he divided into six subgroups, *homo ferus*, *americanus*, *europaeus*, *asiaticus*, *afer*, *monstrosus*. The first and last of these groups may be disregarded, the first as non-existent, the last as pathological. The others are representative of the human types inhabiting the four large continents, described according to outstanding traits of a number of extreme forms. This procedure, on which the whole Linnaean classification is based, was in his case unavoidable because of the lack of detailed knowledge of the distribution of human types. It is interesting to note that in the description of each race mental traits are included as biological characteristics. Buffon considered the human races as varieties derived from an original white form and developed under the influence of climate. Blumenbach distinguished five races of man—Caucasian (European), Mongolian, Ethiopian, American and Malayan. His divisions are based on distinction of color, hair and descriptive features of skull and face. Later, form of hair, color, form of nose and shape of skull became the primary criteria by which races of man were distinguished. The number of races so obtained varies from three or four to thirty-four. Huxley distinguished five races—Australioid, Negroid, xanthochroic, Mongoloid, melanochroic. Deniker established seventeen groups subdivided into twenty-nine races. By a similar method Duckworth derived seven principal races. The types of Europe have been described in particular detail. Ripley's division in the blue eyed, tall Nordic; the darker, short headed Alpine; and the short, long headed Mediterranean is still much used; although later attempts at finer divisions have been used by Deniker, Hans Günther and many others.

In more recent times attempts have been made to place races in definite order, either phylogenetically, by trying to show that one type gave rise by diversification to a new type; or by investigating whether some types have retained in their adult forms earlier stages of individual development. Fritsch distinguished three fundamental races and derived from these metamorph, or mixed, races. Stratz distinguished protomorph, archimorph and metamorph races. The protomorph races, that is, those remaining on a very primitive level with specializations in which the large archimorph races do not participate, are determined not anatomically, but by the isolation of the inhabited area in which ancient animal forms occur and by the low cultural level of the people. The intermingling of biological and cultural viewpoints vitiates this classification. Klaatsch also is interested in the establishment of a phylogenetic order of existing and prehistoric races. The most recent attempt at a detailed phylogenetic classification is that of von Eickstedt.

These attempts at classification are based on purely anatomical characteristics, except in so far as mental traits are sometimes brought in as secondary features. Friedrich Müller, on the other hand, classified races first of all by form of hair, then by language. The intermingling of anatomical and linguistic traits cannot result in an understanding of the biological relation of races.

Equally remote from biological interpretation of racial forms are the attempts at classification based on cultural conditions, from which certain kinds of racial mentality are derived. On a purely deductive basis Carus posited the existence of four races, those of day, night, eastern dawn and western dawn; that is, Europeans, Africans, Mongoloids and Americans. Klemm divided mankind into an active (male) and a passive (female) group, the latter containing all human forms except the Europeans and west Asiatics. His anatomical characterization of the two groups is altogether inadequate. In recent times the belief in a close interrelation between mental behavior and bodily build has come to be a matter of great social importance. Positive evidence for such relation has never been given.

The similarity of form of closely allied races early led anthropologists to introduce quantitative values in place of vague verbal descriptions. Thus Daubenton and Camper introduced measurements of angles. Later linear measurements, particularly of the skull, came into general use and in 1842 Retzius utilized as a distinguishing criterion the so-called cranial index—the relation of breadth of head expressed in percentage of the length. This procedure, which gives not only the absolute dimensions of body parts but also some indication of form, has been applied to numerous other ratios on the skull as well as on the skeleton and has since become a dominant feature of anthropological research. The method is being applied not only to skeletal material but also to the living, and anthropometric descriptions of types have become the rule.

The length-breadth index has a great taxo-

nomic value in distinguishing local varieties of man; it can be determined with great accuracy on the living, and the values obtained on the living and on skeletal material are nearly identical. For this reason this index has gained particular currency as an identifying mark of racial types. It gives a numerical value for striking differences in the appearance of head or skull as seen from above.

Since the numerical values, including the indices, range almost continuously from certain minimum to maximum values in individuals of each local type, it has been found convenient to form three groups—one including the lowest values, another the middle values, the last the highest values—and to classify individuals accordingly. For the cephalic index particularly a division has been made into dolichocephalic (long headed), mesocephalic or mesaticephalic (middle headed) and brachycephalic (short headed) individuals or groups. The demarcation of such groups is necessarily arbitrary. Nevertheless, anthropological classification has long been dominated by the concepts of dolichocephalic, mesocephalic and brachycephalic races and the types have been defined further by other measures and indices; such, for example, are those determining the height of the head (the distance of the vertex from a line drawn from ear to ear or the distance from vertex to base of skull) and its relation to the length of the head; or measures and indices of the face, such as the distance from the root of the nose to the chin in its relation to the greatest transversal diameter of the face; or those of the body, like that of the length of limbs in relation to length of trunk.

These numerical values give an inadequate impression of form, because in every case only two measures are used to identify a complex form. Heads or skulls with the same cephalic index or the same height index may differ materially in form. This inadequacy of the purely metrical method was felt by investigators thoroughly trained in anatomy, and in recent times there have been an increasing number of attempts to base the characterization of races on morphological traits. Sergi classified skull form according to general form rather than according to index values. Many special investigations of skeletal forms, teeth, hair, soft parts of the body and blood are based on these principles.

On account of the lack of information regarding the degree of hereditary fixity of the traits dealt with, classifications based on them have no genetic value. This is true of the elaborate classification of races by Deniker, in which stature and cephalic nasal and facial index are prominent features. It is not known to what extent any of these traits can be considered as stable or subject to fluctuations caused by outer conditions which, in conjunction with genetic determinants, result in observed forms. If these fluctuations are considerable and conditions change, they may modify more or less fundamentally the taxonomic classification.

Races have been considered as well defined units. Actually the picture of the race has been constructed as that of an individual who possesses all the most pronounced traits of the group considered or, in the case of metrical values, who shows the most frequent value, which is assumed to be the average value of the measures. It has been recognized more and more clearly that this view involves an inadequate simplification of the actual conditions. Ever since Quetelet it has been understood that the type represented by the average value of descriptive or metric values is a fiction and that in every case the race must be described by a statement of the distribution of the multiplicity of forms occurring within it. A statistical method of description is therefore required and is receiving increasing attention.

It has become customary to assume that individuals representing a race are distributed approximately according to the law of chance (the exponential law) or some other law closely related to it, and to describe the measurements occurring in a type by their average and their standard variability; that is, the average of the square of all individual deviations from the average. Races differ not only when their averages differ but also when their variabilities differ. On this basis there have been drawn geographical distributions of average values and of variabilities of local types, which demonstrate the gradual transitions between local types. Maps also have been prepared, showing the frequency of certain selected forms, like the distribution of tall or short, long headed or round headed sections of a population. These are of doubtful value, since the limits of these classes are arbitrary and the erroneous impression is conveyed that they represent distinctive racial types.

The study of averages and variabilities has proved that human populations inhabiting adjoining territories overlap in regard to most features, so that it is not possible to assign with certainty any one individual to a definite group.

It is only when races of widely separated areas are compared that there is no overlapping. Criteria of fundamental races are valid only when they are common to all individuals of the race and are not found in other races. Thus the dark pigmentation, the frizzly hair, the broad nose of the true Negro are racial characteristics as contrasted with the slight pigmentation, blond, wavy hair and narrower nose of the north European. Keith calls such races pan-diacritic. There are no races of man in which no overlapping occurs in regard to all the traits examined. Negroes and Europeans may be tall or short, round headed or long headed, large or small brained. The averages and variabilities of these traits may differ, but the distributions are such that many if not most values are common to both races. Nevertheless, human types which are fundamentally distinct in regard to any one hereditary trait must be considered in this respect as distinctive genetic lines and the origin of their peculiarity as well as what they have in common with other groups deserves special attention.

It follows from these observations that stature and cephalic index can be considered as fundamental racial criteria in exceptional cases only, notwithstanding their value as characterizing local varieties. Since they occur in almost all races with the same values, they must be regarded as late developments. The dwarfish stature of the Bushmen and of other pygmy tribes is an instance in which stature becomes a discriminatory character.

Exact descriptions of human types are based on the observation or measurement of many traits. On the whole the interdependence (correlation) between traits is not very great. Thus the individuals who conform to the combination of the most frequent traits are actually very few. In a population consisting of varying individuals all those who deviate too much from the middle group are liable to be excluded as atypical and the "pure" type may perhaps be defined as including only individuals of the middle group. Then only one half of the population would have one typical trait, one fourth would have two typical traits and only one in 1024 would have ten typical traits, provided the selected traits are unrelated. The type, therefore, has no reality but is derived subjectively from the impression of the observed forms. When the variability of the group is very small, the individual differences permit the grouping of many more than one half of the series as true to type which will then come much nearer to reality. There are, however, few populations whose variability is so low that the type is ever realized. For this reason the selection of typical individuals must always be ascribed largely to a subjective, selective process.

The problem of race must, however, be attacked not only as a taxonomic question but also from the point of view of the genesis of racial form. The hereditary, environmental (peristatic) and selective influences which determine racial forms must be considered. Hereditary traits in man have been studied not so much from the racial point of view as from that of hereditary traits in given families. Besides eye color and a few other traits pathological phenomena have received particular attention. The relative importance of environment and heredity has been analyzed by means of investigations of identical twins. The value of these investigations of heredity in individual lines must not be underrated, but the results should not be ascribed directly to the hereditary behavior of races. These may be homogeneous and heterogeneous in two ways. A group descended from a small group of ancestors of the same hereditary form will be uniform throughout, as, for example, the Eskimo of north Greenland, who represent remarkably uniform measurements. In these cases both the averages of the family lines and the members of a fraternity will be alike. In the case of descendants of ancestors of distinct form who have been inbred for many generations the averages of the family lines will also be uniform, but ordinarily the members of each fraternity will differ considerably among themselves, because in regard to certain traits they will revert to the ancestral forms. The family lines will be uniform and each a good representative of the whole population, while individuals may differ greatly. The population is homogeneous as to family lines, heterogeneous as to descent. Finally, there are populations in which the family lines are very distinct and in which the fraternities may be uniform or heterogeneous, according to the descent of the family line. These differences are obscured in the usual descriptions of the variability of populations, which actually consists of two parts, the variability of family lines and also of fraternities; these must be separated. Even in the most rigidly inbred communities considerable differences in family lines have been found, differences which are much larger than those between neighboring groups each taken as a whole. Heredity exists solely in the distinct family lines,

not in the racial group, and the genetic analysis must be founded on a study of the behavior of the component family lines.

If the family lines were identical and derived from a single morphological source, selective mating could have no influence upon the racial type; if the origin of such a population is diverse and there is a tendency to preferential mating between certain forms, the family lines may become distinct. If the family lines are diverse and there is no preferential mating, they will become more uniform during a period of continued inbreeding. If there is preferential mating, the diversity may even increase. Differential mortality, fertility or differential tendency to migrate may also influence the distribution of types and the taxonomic appearance of the general type. Johannsen calls the population consisting of a multiplicity of family lines a phenotype, while the family lines would correspond to his genotypes. The term phenotype is also used to designate the modification of the genotype due to peristatic causes, and some confusion arises if the distinction between these two meanings is not kept in mind. In the latter sense every individual is a phenotype, and genotypes per se are non-existent because all individuals are subject to peristatic influences. A genotype not subject to peristatic influences does not exist.

On account of the overlapping distribution of forms types characterized by the same morphological traits may be found in populations representing different types. The mere fact that certain traits of such individuals are identical must not be interpreted as meaning that they are genetically identical; children of like pairs which belong to different populations will have unlike descendants, for these will tend to revert to the general type of the population to which they belong. Thus children of mesocephalic Bohemians will be on the average more brachycephalic, while children of mesocephalic Sicilians will tend to be more dolichocephalic than their parents.

The taxonomic classification of mankind does not answer the question as to whether the form is determined by heredity or by environment. For an understanding of the significance of racial characteristics the question of the hereditary stability of traits selected for taxonomic description is all important, a fact which was recognized by Meigs, who tried to show by comparative studies the stability of cranial forms.

Among the metric values used by most investigators are those for which sufficient hereditary stability cannot be proved. One of these is the value of stature. There is ample proof that stature has been constantly increasing among west European and North American populations since the middle of the past century. It must be understood that modifications in metric values do not mean that these measures are entirely non-hereditary. It merely signifies that they are subject to outer influences, whose extent should be known if they are to be used for a classification which has a genetic value. Non-hereditary variations are called paravariations; those genetically determined, idiovariations. When stature is used as a criterion and it increases by reason of outer conditions, a people may pass from a type characterized as of medium stature to one of tall stature. The same may occur in regard to other characters. There are clear differences in head form between wild animals and their descendants born in captivity; these find expression in the proportions of the skeleton and particularly in those of the skull. The evidence showing analogous changes in head form among European immigrants in the United States has never been disproved. It is not definitely known to what extent these measures may be modified. The value of measures, as genetically significant, depends upon knowledge of the degree to which they may vary under changing conditions. The cephalic index of east European Jewish immigrants who came to the United States between 1870 and 1909 was a little over 83. That of their own children born more than twenty years after the immigration of the mother is a little below 80. Thus the descendants may easily fall into a taxonomic class distinct from that of the parents. Changes like those here discussed are probably not far reaching, although they render a taxonomic grouping of closely allied forms, like those of Europe, of doubtful value as genetically determined types.

Even more important is the problem of the interpretation of the difference in form of fundamentally distinct races, like Europeans and Negroes. Hahn was the first to point out that the mode of life of man is that of a domesticated animal. Since fire and tools were in use in quaternary times, man may even be said to be the oldest domesticated form. Anatomically the analogy between human races and domesticated animals has been substantiated by Fischer and Klatt. Man shares with domesticated animals great variability of bodily traits, while the features of wild animals are much more uniform.

Such traits as form of hair, pigmentation and size which show increased variability likewise differ in domesticated animals. The spiral hair of the Bushmen and the smooth hair of the Mongol, the blond hair and blue eye of the north European and the deep pigmentation of the Negro, the tallness of the Scotsman and the dwarfish stature of the pygmy, are paralleled by analogous phenomena among domesticated animals, while they are absent among wild animals. It is conceivable therefore that the differentiation of races is not as ancient as might be supposed from the contrast of existing forms.

It has been pointed out also that races conform more or less to the constitutional types found in one's own population. It has been shown by Weidenreich that thin, elongated types (leptosome) and heavy set (eurysome, pyknic) types occur in every population and that the attempt to analyze a race as derived from two distinct elements is based on a subjective classification, not on genetic evidence. The distinctive constitutional forms are due rather to the relatively close interrelation between all linear measures among themselves and all transversal measures among themselves, while the correlation between the two types of measures is slight. Furthermore the apparent constitutional type depends upon use of the muscular system and upon age. Active exercise of the muscular system stimulates the growth of bones in thickness but not in length, so that energetic muscular activity in youth increases the number of eurysome individuals. Age also has a decided effect; middle aged persons are on the whole more eurysome than the young and the very old. It has been observed that city children are on the average more leptosome than children brought up in the country. It must be recognized that there are certain middle values in each race which according to standards of one race may be leptosome or eurysome, but which form the central point from which more slender or more heavily set individuals deviate. Observations as to constitution in one race cannot be transferred directly to another.

The activity of the endocrine glands has a decided influence upon the development of the body of an individual. Removal of testes or ovaries leads to disturbances of growth. The secretions of the thyroid and pituitary glands and of the adrenals have a distinct influence upon bodily form. If the secretions were subject to local influences, they might bring about modifications of bodily form in local groups. Their role in the differentiation of races has not been determined.

It seems quite certain that such differentiation of fundamental forms as now exists must have developed during periods of isolation of small groups. Such periods must be quite remote in time, for there is clear evidence of constant migrations and intermingling of peoples. For Europe the example of the history of Spain, at present a part of the continent least affected by migration, is instructive. In early times it was inhabited by Iberians whose racial affiliation is not determined in detail; later Phoenician colonies were founded along the coast. During the era of Celtic migrations waves of these people entered Spain from France. Then followed Roman colonization. Still later Germanic tribes invaded the peninsula and remained for a long time the governing class. Invasions from north Africa brought a large part of Spain under Moorish dominion. Large numbers of Jews settled in Spain during the early centuries of the modern period and intermarried with other elements of the population.

The Celtic tribes swarmed southward, northward and eastward. They occupied the British Isles, entered Spain and Italy and finally one of their groups even established itself in Asia Minor. The Germanic tribes, which had formerly lived in the area extending from the Black Sea to the North Sea, migrated westward and southward; deserting their eastern homes and invading western and southern Europe, they even reached north Africa. Their former homes were largely taken over by Slavs who expanded northeastward from their home somewhere in southeastern Europe, intermingling particularly with Finnish tribes. Later the Germans reoccupied part of the territory they had given up earlier and assimilated the people east of the Elbe. While these migrations can be followed historically, others may be inferred from evidence of prehistory. Thus the people speaking Italic and Greek languages must have superseded previous occupants of the southern peninsulas of Europe.

The same conditions prevailed on other continents. Peoples related to the Malays of southeastern Asia migrated eastward, inhabited the islands of the Pacific Ocean and reached westward Madagascar on the east coast of Africa. The Turkish peoples expanded from central Asia into Siberia and southward into Europe. In America the Athapascans extend from the Arctic coast into northern Mexico, the larger

groups living in the subarctic area from Hudson Bay to Alaska and in the Rio Grande region, while small groups are found in many localities near the Pacific coast. In South America the Caribs are scattered over a vast territory. The relations between these groups have been determined by linguistic comparisons, but since languages spread only by personal contact and almost always by intermarriage they are satisfactory proof of migration.

Even in earliest prehistoric times migrations must have occurred. The sudden change from the Neandertal type prevailing at the end of the older palaeolithic period to the new type of the later palaeolithic can be explained only by migration, for there is no ground for assuming that the new type developed suddenly in Europe. One of the greatest early migrations must have been the invasion of America, which may have occurred toward the close of the ice age. Since no predecessor of man has been found in America and there is a close relation between the American Indian and the Mongoloids, it must be assumed that there was an immigration from Asia, early enough to have allowed for a gradual movement of bands which spread from the Arctic through the tropics to the extreme southern part of South America and which became differentiated during this migration.

The period of isolation must have been exceedingly remote and it may be expected that an intermingling of types will be found almost everywhere. It is therefore particularly important that the effect of intercrossing be understood. Even if the evidence offered by prehistory and linguistics regarding the early migrations of man be set aside, the degree of variability of most local types has led to the impression that in most populations several types are present which have to be segregated. Such segregation presents serious difficulties arising from the subjective character of the type. The previous experience of the person who establishes the type concepts will to a certain extent determine the types recognized.

The analysis of a population has been attempted from the point of view that certain of the arbitrarily selected groupings of measures have been assumed as characteristics of primary races, so that, for example, the combination of low cephalic, facial and nasal index would characterize a primary race and the number of races would be determined by the eight possible combinations of these features. On account of the great variability of racial forms this leads to the assumption that every one of these arbitrarily constructed primary races would occur in almost all parts of the world, and by necessity other characteristics, such as pigmentation and hair form, would have to be considered as varying under external conditions. Genetically groups of this kind are unstable. They contain only extreme constitutional forms in a mixed series and the children of parents of extreme form tend to revert to the middle forms of the population. For this reason also their value as primary racial groups cannot be accepted.

In a number of cases it can be shown that a population is actually mixed. In a homogeneous population all the measures of an individual will increase simultaneously. For instance, length and breadth of head will both increase with increasing stature. This would be expressed by a positive correlation between these two head measures. When the population is descended from one ancestral group, a part of which has long and narrow heads, and from another with short and broad heads, the longer heads will have less breadth than the shorter ones. There will be a strongly diminished or even negative correlation due to mixture. Conversely, if one type has small measurements and the other large measurements, there will be an increase in the value of the correlation. Such disturbances of normal relations may reveal the intermingling of types, although the components, unless actually found in some locality, cannot be reconstructed. Even in this case it would be necessary to know the purely biological relation between the measures, before the attempt at determining the degree of mixture could be made. For these reasons attempts to analyze populations according to the racial descent of the component elements have not been very successful, and the manner in which bodily traits are transmitted makes it very doubtful whether it will ever be possible to segregate the constituent parts out of a population of mixed but unknown descent.

It is essential to know the exact laws of inheritance in mixed forms, a subject about which knowledge is still inadequate although the problem has received some attention. According to Mendelian laws a splitting up of racial characteristics may be expected in certain cases. This simple form of effect of continued crossing between distinct types has not been observed very often. Even before the rediscovery of the laws of Mendelian inheritance von Luschan had observed a reversion to parental types in the head index of the population of Asia Minor, which

he considered as descendants of a very early mixture of the round headed Armenian and the long headed Syrian type. The clearest case is the splitting up of the descendants of blue eyed and brown eyed parents, who follow very closely the simplest forms of Mendelian inheritance. No absolutely certain cases of brown eyed descendants of pure blue eyed parents are known, while crosses between heterozygous brown eyed parents, that is, descendants of parents who each had one blue eyed and one pure brown eyed parent, have nearly 25 percent blue eyed and 75 percent brown eyed children. For the head index an increase of variability has been shown with increasing difference between the corresponding indices of the parents. The width of the face of half blood Indians shows a decrease in variability and at the same time apparently two maxima of frequency, one corresponding nearly to the white, the other nearly to the Indian ancestry. The stature of white-Indian half bloods is greater than that of either ancestral form. Herskovits has shown that for many traits of the mulatto variability is not increased, while according to Barnes the variability of skin color is greatest for quarter Negroes. It has also been shown that the fertility of white-Indian half bloods is greater than that of pure Indians. Evidently the laws of inheritance of different traits are varied and for this reason also a purely statistical analysis of the distribution of traits in a given population cannot be made. A comparison of races must therefore be based on the genealogical study of the component family lines of populations, and the more this is done the less fundamental the difference between racial types appears to be. When racial types like Negroes, Mongols and whites are compared, a purely morphological basis may be used in which the distinguishing characteristics of the race may be discerned; but whenever the features overlap genealogical study becomes indispensable.

Recently much stress has been laid upon the possibility of analyzing races by means of blood groups. Bernstein derives from the behavior of heredity of blood groups the existence of three fundamental racial types, the mixture of which has resulted in the distribution of blood groups in modern populations. The striking difference between the blood groups of the American Indians and the races of the Old World is in curious conflict with the morphological similarity between Indian and Asiatic racial types. The fullest material is available from Europe, where curiously contradictory results have been obtained. It would seem according to Lattes that in closely inbred groups characteristic distributions of blood groups develop, while no appreciable differences are found between more widely scattered groups, such as the Jews of Berlin and Poland, when compared with the remainder of the population of the same places, or between Lapps and Swedes of adjoining territories. In all races, except perhaps among pure American Indians, who may have only one of the recognized blood groups, all groups occur in varying frequency. It seems doubtful whether it is justifiable to claim that every racial type containing the various blood groups must be a mixture of distinct races. So far attempts to correlate blood groups and morphological form have not led to any positive results. The statement of Lattes that the blood group is a character of the same order as pigmentation or shape of the skull is probably a correct summary of present knowledge of the problem.

In a comparison of man and the anthropoid forms a number of striking resemblances are found which indicate the direction in which man has diverged and specialized. The special forms developed in the various races do not show that one can be considered as more advanced from the prehuman type than another. The divergences are rather in different directions. Thus the Negro is most divergent in the increased length of legs and in the strong development of the lips; the Mongoloid in the loss of hairiness; the European in depigmentation, reduction in the size of the face, elevation of the nose and increased size of the brain. The last of these features might perhaps be considered as the most important deviation from lower types, but it is not the sole property of the European. The largest brains are probably found among the Eskimo. The Australian represents perhaps the only racial type characterized by less specialization in specifically human traits than others, but even in this case the divergences from animal forms are in such directions that he can hardly be placed on a lower evolutionary level as compared with other human races. It must also be remembered that the reduced size of the face of the European and the projection of the face of the Negro may be due to influences of domestication, since these forms occur among domesticated races, so that they would have to be considered as secondary modifications rather than as evolutionary stages.

The racial differences in average size of brain are slight as compared with the individual varia-

tions which occur in each race, so that a considerable amount of overlapping occurs. Extremely large values may be rare or absent in one race, extremely low ones in another, while in the bulk of the population the same middle forms will occur. It is not justifiable to identify size of brain and intelligence. The size of the brain depends not upon the number of nerve cells and fibers and their connections, but to a much greater extent upon tissue which has nothing to do with nerve activity. The configuration of the sulci of the brain is also so variable that nothing definite can be inferred therefrom. There are relations between the form of the skull and the configuration of the brain, but the observation of artificially deformed heads suggests that there is no functional relation. The existence of fundamental structural differences likewise has not been proved.

The general question of the cultural significance of race hinges upon the problem of the functioning of the body. While the anatomical form of the adult is almost stable until the time when senility sets in, the functions depend upon varying conditions to such a large degree that a constant, typical value for a measurable function can be given only with great difficulty. The metabolism of the body may be cited as an example. In order to obtain results that are in any way comparable it is necessary to see that sufficient time elapses after the last meal, that there is no exertion of any kind in the period preceding the test and that body and mind are completely relaxed. Unless these conditions are fulfilled the results of the test will differ greatly. Similar conditions prevail in regard to the functioning of the heart. Exercise and excitement accelerate the heart beat, and the amount of available oxygen also has an influence. It follows that an individual who lives in a temperate zone at sea level and leads a quiet inactive life will react quite differently when taken to a high altitude where he has to do strenuous work. Within limits the organism is perfectly adjustable. There is a margin of safety within the limits of which the organism is adjustable to a variety of conditions. It follows conversely that in many cases representatives of different races living under similar outer conditions will appear functionally alike, while individuals of the same race living under different conditions will appear quite distinct. Phenomena of this kind have been observed in the development of the individual. Thus the period of sexual maturity of the well to do is accelerated as against that of the poor; there are differences in the time of dentition and in the climacterium. In a number of cases the same environmental conditions may emphasize differences of type; for instance, in the effect of sunburn, which darkens darkly pigmented types while it reddens those of light complexion.

What is true of physiological functions is equally if not more true of mental reactions. Even such a simple psychophysical phenomenon as reaction time is subject to enormous fluctuations according to the presence or absence of distractions. A certain minimum value may be found for each individual, but the slightest diversion of attention brings about a rise in the reaction time. The variability of the emotional tone of the individual is so obvious that it does not require experimental proof. The differences between mental tone in fatigue and after rest are also obvious.

In the study of anatomical form of the adult only the serial variability must be taken into consideration, for each individual remains stable. In the study of function recognition must be given to a high degree of variability in the individual which is added to the purely structural determinant. It is therefore not surprising that individuals of the same descent react differently under varying outer conditions.

Because of the difficulties of precise quantitative determination of mental traits it is not easy to give satisfactory data in regard to all mental traits. The dependence of such reactions as are measured by various types of intelligence tests offers a fairly satisfactory answer to mental phenomena which can be reached by these methods. Thus Brigham found that among groups of Europeans who had immigrated at various times and had been subjected to intelligence tests those who had stayed longest in the United States gave the best results. While originally he ascribed this to the immigration of more poorly equipped stock in later years, subsequently he withdrew this conclusion. It seems more plausible that the improvement is due to a gradual assimilation to American speech and customs. Klineberg found this to be the case among Negroes migrating from rural districts to cities. The evidence in regard to mental differences between races has been assembled by Garth, who reaches the conclusion that no essential differences have been proved.

The attempt has also been made to evaluate the functions of individuals of different racial types living in the same geographical and social environment. While it is exceedingly difficult to

find an absolutely equal social environment, it may be assumed that it exists approximately in groups living socially on equal terms. The attempt to find definite correlations between European types and their mental performances have not shown any such relations; on the contrary, the only constant difference found is that between rural and city populations.

It would be rash to infer from these observations that there are no differences whatever in the distribution of biologically determined intellect or personality; if exactly the same conditions could be attained for a sufficiently large number of individuals, biologically determined differences might be found, but it seems impossible to attain sameness of conditions. The only safe conclusion to be drawn is that careful tests reveal a marked dependence of mental reactions upon conditions of life and that all racial differences which have been established thus far are so much subject to outer circumstances that no proof can be given of innate racial differences.

Just as in consideration of bodily form individual heredity has to be emphasized as against the fictitious heredity in a large group consisting of many distinct lines of descent, so the same distinction has to be made in regard to mental traits. The tenets of the behavioristic school of psychology, in so far as they deny all influences of bodily build upon mental activities, can hardly be maintained. The contrast between the extremes, between idiot and genius, contradicts their assumption; if these are dependent upon bodily build, then lesser differences also will find expression. It is intelligible, perhaps demonstrable, that identical twins or members of a family show similarities in behavior that are, in all probability, hereditary. In a larger, not inbred group there must be so many differences between family lines that it is not possible to speak of racial heredity.

The observation which has given particular strength to the assumption that bodily form and mental characteristics are closely correlated lies in the peculiar distribution of human types and of cultures. In each area a certain type and a certain culture are found locally associated. Similar conditions may prevail in social strata of the same population, and from this the inference is drawn that they must be causally related in the sense that bodily form determines the culture. Such an inference is admissible only if it can be substantiated by biological evidence. The limits of racial types are not clean cut, and similar individuals always occur in neighboring groups. The limits of distribution of cultural types are also not distinct and do not conform to the limits of racial types. The type of one area is defined by its main features, and the culture of the same area is also characterized by its chief traits. If the geographical grouping is made by racial types, there must result a corresponding grouping of cultural traits which is due to the selection of areas (or sections of a population) without any necessary causal relation between the two groups of traits. A positive answer to the claim that racial descent determines mental characteristics would require proof that without regard to cultural environment and to location the same type must always produce the same mental characteristics.

If there is any truth in the fundamental generalizations of Mendelian inheritance, it must be expected that various traits of the body which are not intimately associated are inherited independently of one another, so that in the intermingling of genetic lines ever new combinations will arise. It has never been proved that form of the head, color of hair and form of nose have any intimate association with mental activities. Karl Pearson has followed a rigid method in investigating such possible correlations and his results are entirely negative. Unless such proofs can be given, the interpretation of character by bodily form remains as imaginary as that of the phrenologist. The weak correlation between constitution and pathological conditions, and particularly mental diseases, might be brought forward as indicating the possibility of such relations, but even here no one would claim that every person of leptosome type must be manic depressive and one of pyknic type schizophrene.

It must be emphasized that no proof has been given that the distribution of genetic elements which may determine personality is identical in different races. It is likely that there are differences of this kind, provided the anatomical differences between the races are sufficiently fundamental. On the other hand, the study of cultural forms shows that such differences are altogether irrelevant as compared with the powerful influence of the cultural environment in which the group lives. While each individual may react in his own way to the culture in which he lives, the behavior of the whole group conforms to its standards. This conclusion was expressed by Waitz as early as 1858 and is the basis of all serious studies of culture.

FRANZ BOAS

See: RACE MIXTURE; HEREDITY; MAN; ARYANS; EN-

VIRONMENTALISM; DOMESTICATION; MISCEGENATION; INTERMARRIAGE; ETHNOCENTRISM; NATIONALISM; RACE CONFLICT; MIGRATIONS; ANTHROPOMETRY; MENTAL TESTS; EUGENICS; ADAPTATION; AMALGAMATION; DEGENERATION; ANTHROPOLOGY; CULTURE.

Consult: Topinard, Paul, *Éléments d'anthropologie générale* (Paris 1885); Deniker, Joseph, *Les races et les peuples de la terre* (2nd ed. Paris 1926), tr. as *The Races of Man* (London 1900); Günther, H. F. K., *Rassenkunde des deutschen Volkes* (14th ed. Munich 1930); Duckworth, W. L. H., *Morphology and Anthropology* (2nd ed. Cambridge, Eng. 1915); Fritsch, Gustav, "Geographie und Anthropologie als Bundesgenossen" in Gesellschaft für Erdkunde zu Berlin, *Verhandlungen*, vol. viii (Berlin 1881) 234–51; Stratz, C. H., *Naturgeschichte des Menschen* (Stuttgart 1904), and "Das Problem der Rasseneinteilung der Menschheit" in *Archiv für Anthropologie*, vol. xxix (1903–04) 189–200; Klaatsch, Hermann, "Die Aurignac-Rasse und ihre Stellung im Stammbaum der Menschheit" in *Zeitschrift für Ethnologie*, vol. xlii (1910) 513–77, and *Der Werdegang der Menschheit und die Entstehung der Kultur*, ed. by Adolf Heilborn (2nd ed. Berlin 1922), tr. by Joseph McCabe as *The Evolution and Progress of Mankind* (London 1923) ch. xiv; Eickstedt, Egon von, *Rassenkunde und Rassengeschichte der Menschheit* (Stuttgart 1933); Carus, C. G., *Ueber ungleiche Befähigung der verschiedenen Menschheitstämme für höhere geistige Entwickelung* (Leipsic 1849); Klemm, G. F., *Allgemeine Cultur-Geschichte der Menschheit*, 10 vols. (Leipsic 1843–52) vol. i, p. 195–205; Hankins, Frank H., *The Racial Basis of Civilization* (New York 1926); Simar, Théophile, *Étude critique sur la formation de la doctrine des races*, Académie Royale de Belgique, Classe des Lettres et des Sciences . . . , Mémoires, 2nd ser., vol. xvi, pt. 4 (Brussels 1922); Sergi, Giuseppe, *L'uomo secondo le origini, l'antichità, le variazioni e la distribuzione geografica* (Turin 1911); Martin, Rudolf, *Lehrbuch der Anthropologie in systematischer Darstellung*, 3 vols. (2nd ed. Jena 1928); Quetelet, L. A. J., *L'anthropométrie* (Brussels 1871); *Biometrika*, ed. by Karl Pearson and others, published irregularly in Cambridge, Eng. since 1901; Retzius, Gustaf, and Fürst, C. M., *Anthropologia suecica* (Stockholm 1902); Livi, Ridolfo, *Anthropometria militare*, 2 vols. (Rome 1896–1905); Boas, Franz and H. M., "The Head-Forms of the Italians as Influenced by Heredity and Environment" in *American Anthropologist*, n.s., vol. xv (1913) 163–88; Boas, Franz, "Notes on the Anthropology of Sweden" in *American Journal of Physical Anthropology*, vol. i (1918) 415–26; Keith, Arthur, *Ethnos; or, the Problem of Race Considered from a New Point of View* (London 1931); Gates, R. Ruggles, *Heredity in Man* (London 1929) ch. xvi; Fischer, Eugen, "Die Rassenunterschiede der Menschen" in Baur, Erwin, Fischer, Eugen, and Lenz, Fritz, *Menschliche Erblichkeitslehre und Rassenhygiene*, 2 vols. (3rd ed. Munich 1927), vol. i, tr. by Eden and Cedar Paul in their *Human Heredity* (London 1931) sect. ii, and "Versuch einer Genanalyse des Menschen" in *Zeitschrift für induktive Abstammungs- und Vererbungslehre*, vol. liv (1930) 127–234; Verschuer, O. von, "Ergebnisse der Zwillingsforschung" in Gesellschaft für physische Anthropologie, *Verhandlungen*, vol. vi (1931–32) 1–65; Boas, Franz, "Die Variabilität von Volksgruppen" in *Anthropologischer Anzeiger*, vol. vii (1930–31) 204–08; Carter, Isabel Gordon, "Reduction of Variability in an Inbred Population" in *American Journal of Physical Anthropology*, vol. xi (1927–28) 457–71; Johannsen, W., *Elemente der exakten Erblichkeitslehre* (3rd rev. ed. Jena 1926); *Indigenous Races of the Earth*, ed. by J. C. Nott and G. R. Gliddon (Philadelphia 1857); Bowles, Gordon Townsend, *New Types of Old Americans at Harvard* (Cambridge, Mass. 1932); Steensby, H. P., "Foreløbige Betragtninger over Danmarks Raceantropologi" in Denmark, Anthropologiske Komite, *Meddelelser om Danmarks Antropologi*, vol. i (1907–11) 83–148, summary in English, p. 161–72; Boas, Franz, "Changes in the Bodily Form of Descendants of Immigrants" in *American Anthropologist*, vol. xiv (1912) 530–62; Guthe, C. E., "Notes on the Cephalic Index of Russian Jews in Boston" in *American Journal of Physical Anthropology*, vol. i (1918) 213–23; Fischer, Eugen, *Rasse und Rassenentstehung beim Menschen*, Wege zum Wissen, vol. lxii (Berlin 1927); Klatt, Berthold, "Mendelismus, Domestikation und Kraniologie" in *Archiv für Anthropologie*, vol. xlvi (1920–21) 225–50; Weidenreich, Franz, *Rasse und Körperbau* (Berlin 1927); Keith, Arthur, "The Evolution of the Human Races" in Royal Anthropological Institute of Great Britain and Ireland, *Journal*, vol. lviii (1928) 305–21; Haddon, A. C., *The Wanderings of Peoples* (Cambridge, Eng. 1911); Dixon, Roland B., *The Racial History of Man* (New York 1923); Boas, Franz, "The Cephalic Index" in *American Anthropologist*, n.s., vol. i (1899) 448–61; Czekanowski, Jan, "Le problème de la synthèse des cartogrammes et les types anthropologiques" in *Anthropologie*, vol. ii (1924) 151–64; Stolyhwo, K., "Sur la méthode de la diagnose différentielle" in *Anthropologie*, vol. iv (1926) 220–26; Boas, Franz, "The Half-Blood Indian" in *Popular Science Monthly*, vol. xlv (1894) 761–70; Fischer, Eugen, *Die Rehobother Bastards und das Bastardierungsproblem beim Menschen* (Jena 1913); Sullivan, Louis R., *Anthropometry of the Siouan Tribes*, American Museum of Natural History, Anthropological Papers, vol. xxiii, pt. 3 (New York 1920); Rodenwaldt, Ernst, *Die Mestizen auf Kisar*, 2 vols. (Batavia 1927); Herskovits, M. J., *The American Negro; a Study in Racial Crossing* (New York 1928), and *The Anthropometry of the American Negro*, Columbia University, Contributions to Anthropology, vol. ii (New York 1930); Dunn, Leslie C., *An Anthropometric Study of Hawaiians of Pure and Mixed Blood*, Harvard University, Peabody Museum of American Archaeology and Ethnology, Papers, vol. xi, no. 3 (Cambridge, Mass. 1928); Barnes, Irene, "The Inheritance of Pigmentation in the American Negro" in *Human Biology*, vol. i (1929) 321–81; Davenport, C. B., and Steggerda, Morris, *Race Crossing in Jamaica*, Carnegie Institution of Washington, Publication no. 395 (Washington 1929); Williams, G. D., *Maya-Spanish Crosses in Yucatan*, Harvard University, Peabody Museum of American Archaeology and Ethnology, Papers, vol. xiii, no. 1 (Cambridge, Mass. 1931); Luschan, Felix von, "Die Tachtadschy und andere Ueberreste der alten Bevölkerung Lykiens" in *Archiv für Anthropologie*, vol. xix (1891) 31–53; United States, Bureau of the Census, *Indian Population in the United States and Alaska, 1910*, by R. B. Dixon and F. A. McKenzie (1915) 157–60; Lattes, Léone, *L'individualité du sang en biologie, en clinique et en médecine légale* (Paris 1929), tr. by L. W. H.

Bertie (London 1932); *Handbuch der Blutgruppenkunde*, ed. by Paul Steffan (Munich 1932); Kappers, C. U. A., "On Some Correlations between Skull and Brain" in Royal Society of London, *Philosophical Transactions*, ser. B, vol. ccxxi (1932) 391–429; DuBois, Eugene F., *Basal Metabolism in Health and Disease* (2nd ed. Philadelphia 1927); Meltzer, S. J., "The Factors of Safety in Animal Structure and Animal Economy" in *Journal of the American Medical Association*, vol. xlviii (1907) 655–64; Ploss, H. H., and Bartels, Max and Paul, *Das Weib in der Natur- und Völkerkunde*, 3 vols. (11th ed. by F. E. von Reitzenstein, Berlin 1927) vol. i, p. 666–93; Boas, Franz, "Studies in Growth" in *Human Biology*, vol. iv (1932) 307–50, and vol. v (1933) 429–44; Schaeffer, R., "Über Beginn, Dauer und Erlöschen der Menstruation" in *Monatsschrift für Geburtshülfe und Gynäkologie*, vol. xxiii (1906) 169–91; Brigham, Carl C., *A Study of American Intelligence* (Princeton 1923) sects. viii–ix, and "Intelligence Tests of Immigrant Groups" in *Psychological Review*, vol. xxxvii (1930) 158–65; Garth, T. R., *Race Psychology* (New York 1931); Hogben, L. T., *Genetic Principles in Medicine and Social Science* (London 1931) ch. v; Klineberg, Otto, *An Experimental Study of Speed and Other Factors in "Racial" Differences* (New York 1928), and *A Study of Psychological Differences between "Racial" and National Groups in Europe* (New York 1931); Watson, John B., *Psychology from the Standpoint of a Behaviorist* (3rd ed. Philadelphia 1929); Pearson, Karl, "On Our Present Knowledge of the Relationship of Mind and Body" in *Annals of Eugenics*, vol. i (1925–26) 382–406; Bauer, Julius, "Beeinflussung der Tuberkulose durch Konstitution und Krankheiten" in *Handbuch der Kindertuberkulose*, vol. ii (Leipsic 1930) p. 1495–1513; Kretschmer, Ernst, *Körperbau und Charakter* (8th ed. Berlin 1929), tr. by W. J. H. Sprott as *Physique and Character* (London 1925); Waitz, Theodor, *Anthropologie der Naturvölker* (2nd ed. by G. K. C. Gerland, Leipsic 1877), tr. by J. F. Collingwood as *Introduction to Anthropology*, Anthropological Society of London, Publications (London 1863) p. 321–28; Boas, Franz, *The Mind of Primitive Man* (New York 1911), and *Anthropology and Modern Life* (new ed. New York 1932) chs. ii–iii; Lowie, Robert H., *Culture and Ethnology* (New York 1917) ch. ii.

RACE CONFLICT. Race conflicts are among the most important factors of political and social unrest in the contemporary world and their significance increases as racial feeling grows in emotional intensity. Historically such conflicts had their origin in the migration of races and in the conquest of territories already inhabited by other races. Sociologists like Gumplowicz and Oppenheimer hold that states were founded upon conquest and migration and that in organizing society the conquering race constituted itself the ruling class, while the conquered were relegated to servant status. Race therefore became a factor of social superiority, and the philosophers of the ruling race soon made it appear to be a factor of moral and intellectual superiority and of political capacity. The members of the ruling or conquering race, who had all the opportunities for social and cultural development which they denied to the members of the conquered race, came to think of themselves as alone capable, by nature or by the will of God, of providing political and social leadership in the interests of the lower races themselves. The attempt to justify the vested interests of racial exploitation in terms of a mythology of racial superiority found its classical expression in Aristotle. The sophists had taught that the differences between free men and slaves were set by human convention, that slavery had been established by force and was therefore unjust. Aristotle, on the contrary, maintained that the differences between free men and slaves were set by nature, that some races are destined to mastery and others to slavery, involving a burden for the master and a benefit for the slave. In the Aristotelian view racial conflicts are not historical or sociological phemonena but belong to an eternal order of God or nature: there is no hope of changing racial inequality into equality by patient educational and social work or by revolution; race conflicts can be avoided and a natural harmony arrived at only if the inferior races accept the status imposed upon them by eternal law. This school of thought regards racial prejudice as a fundamental human instinct.

Class differences have been explained in terms of racial differences by such writers as Henri de Boulainvilliers, who conceived of the French aristocracy as Franks, or Germans, who had subdued the native French Gauls, or Celts: the political, social and economic inequality of the classes in France was thus justified by and based upon irreparable racial inequality. Sieyès, in his *Qu'est-ce que le tiers état?* (1789), explained the French Revolution as the effort of the conquered race to expel the ancient conquerors and thus to right a historical wrong by restoring the third estate to the noble rank it had held before the invasion of the Franks. Gobineau, in his *Essai sur l'inégalité des races humaines* (4 vols., Paris 1853–55), held that the Germans, whom he identified not with contemporary Germans but with the French aristocracy, were the supreme race and the initiators of all human progress. Houston Stewart Chamberlain and his German followers have ascribed all civilizations in the history of mankind to the influence of conquering German tribes and attributed the decay of those civilizations to the