plasmic bodies surrounding the rather large, vesicular nuclei send off tapering processes. The latter branch and anastomose freely with those of neighboring cells. The large intercellular spaces are filled with mucin, and

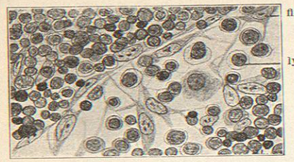


FIG. 1496.—Reticular Connective Tissue from Lymph Gland of Dog. The upper left-hand portion of the figure consists of adenoid or lymphoid tissue. × 600.

there are also a few poorly developed fibres. The mucin gives the whole the peculiar jelly-like, translucent look in gross amounts. which is familiarly seen in the umbilical cord. The umbilical cord represents its only normal occurrence in man. It is more abundant in lower forms of life. In the human adult it is not normally present at all. Pathologically it is seen in myxomata, the commonest example of which is the ordinary nasal polyp.

Reticular connective tissue is a highly specialized form of connective tissue found in the spleen, lymph glands, tonsils, the solitary and agminated follicles of the intestine, the submucosa of the digestive tract, and in other places. Its structure has always been obscure. Ordinary microscopical sections show little more than a mass of nuclei. These are easily seen, however, to be of two sorts (see Fig. 1496). Some are small, deeply stained, and round. Others are often oval, larger, vesicular in character with a well-marked nuclear membrane and with nuclear contents staining but faintly save for one or more granules of chromatin—in other words, nuclei like those of the mesenchyma. Careful study of favorable sections will show some of the protoplasmic bodies of the cells to which these nuclei belong. The outlines of the cells to which belong the small dark nuclei are simply circles—in other words the cells are like the young mononuclear leucocytes and are hence called "lymphoid" cells. The other nuclei are sometimes surrounded by irregular masses of protoplasm with obscure branches. They are the fixed connective-tissue cells of the part. The lymphoid cells are not fixed, but may be regarded as simply floating in the matrix. The differences between the two types of cells are well shown in the accompanying illustration (Fig. 1496).

If we treat a section in appropriate reagents and shake it vigorously before mounting, most of the lymphoid cells may be removed and the other parts show more clearly. Such a section shows a network of rather large anastomosing strands containing the nuclei of the fixed cells. Its appearance resembles very closely that of the omentum of certain animals, such as the dog. Here instead of being two layers of flattened epithelial cells with a little connective tissue between, as in man, the omentum consists of an open-meshed network of delicate fibres, the latter being surrounded by tube-like sheaths of cells, so that the whole is like a sieve full of holes. Ordinary specimens show neither fibres nor cell outlines, but only the nuclei lying upon the strands of the network. Now shaken sections of reticular tissue look like this, except that the fibres are not all in one plane, but run in many directions.

This appearance has given rise to a controversy in which the last word has not yet been spoken. Does the reticulum consist of a network of cells alone, or of fibres alone, or of fibres with cells in close relation to them? It seems to the writer that this question is answered by specimens in which all of the cells have been removed by digestion, or in which only the fibres are stained. In such sections we still see a network of fibrillated fibres interlacing and crossing one another in all directions so as to make a framework. These fibres, in organs like lymph glands, are continued directly into the more densely packed fibres of the capsule. In the fresh state the fibres are surrounded by the flattened connective-tissue cells which make sheaths, more or less definite, about them, in much the same way as do the endothelial cells in the dog's omentum. That this is the case is also proven by staining in such a way as to show the outlines of the individual cells. This flattening out of mesenchymal cells to form membranes is seen in many other regions,—notably in the endothelia of the blood-vessels. The intercellular, anastomosing processes are doubtless preserved, and if we assume that these fixed cells are also connected by their protoplasmic processes with the connective-tissue cells in the capsule the relations become clear. Each of the fibres of reticular connective tissue, then, consists of a central core of fibrillæ surrounded by a more or less definite tube of flattened mesenchymal (endothelial) cells. According to Mall the fibres in reticular connective tissue differ both from the white fibres and from the yellow elastic network, and consist of a third substance called reticulum.

The terms *adenoid tissue* and *lymphoid tissue* refer to a form of reticular tissue whose spaces are filled full of floating lymphoid cells, so that the fixed cells are vastly outnumbered. Such tissue is found in the tonsils, the secondary nodules of the lymph glands, the Malpighian corpuscles of the spleen. the solitary follicles, and Peyer's patches of the intestine. This tissue is represented in a portion of Fig. 1496.

Areolar or *interstitial tissue* is a loose form of connective tissue where the fibres and strands of the elastic network run in all directions, not being disposed in layers. Such is the tissue shown in the teased specimen represented in Fig. 1491. It is perhaps the most typical form of connective tissue. It occurs underneath the skin and mucous membranes, about the vessels and nerves, and in the various places where its function is to connect loosely parts between which a considerable degree of motility is required.

Fibrous membranes, like the periosteum and perichondrium, the fasciæ and the dura are made up of connective tissue of the adult type. The fibres are especially well developed and make up the greater bulk of the tissue. They are densely packed together so that there is little fluid matrix. A small amount of elastic network is present even in places where elasticity is hardly a feature of the gross membrane, as in the periosteum.

Ligaments and tendons (Figs. 1497 and 1498) are also made up of dense connective tissue, the most marked histological peculiarity being that the fibres all run in the same direction and are gathered into parallel bundles. The cells occur between these bundles, their form and

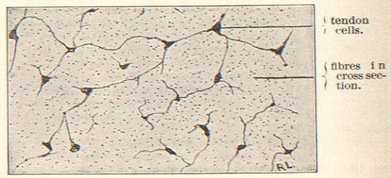


FIG. 1497.—Cross Section of Tendo Achillis. × 332.

arrangement being determined by the positions in which they lie. Thus they form characteristic chains, as is well shown in Fig. 1498. It will be noticed in such longitudinal sections that the nuclei are generally near the ends of

the cells. Often the cells appear to be in groups of two, for the reason that the nuclei of a pair of cells are in the adjacent ends of their respective cell bodies. The nuclei may be flat or they may be round or oval. In such longitudinal sections we see little trace of the stellate form that the cells once had when they formed part of the embryonic mesenchyma. In cross sections (Fig. 1497), however, we see a strikingly different picture. We now have stellate cells whose long processes anastomose freely —those of one cell with those of another. In fact, each tendon corpuscle sends out lateral lamellar processes, lying in planes parallel to the general direction of the

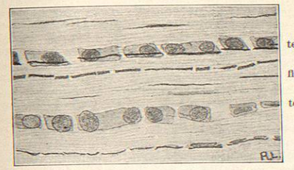


FIG. 1498.—Longitudinal View of Tendon of Rat's Tail. × 450.

tendon, and these lamellæ break up into the anastomosing branches. Hence the striking difference in appearance between cross and longitudinal sections.

There are many other special modifications of connective tissue, such as the submucosa of the uterus and the cornea and sclera of the eye, but these are best treated in connection with the organ to which they belong. There are also tissues belonging to the third group in the classification of mesenchymal tissues—structures developed from the mesenchyma by changes both in the cells and in the intercellular matrix. These are not commonly classed as connective tissue at all, but they are closely allied to it. Take, for example, the walls of the arteries. Nothing enters into their composition but mesenchymal cells and the various intercellular structures of connective tissue. The flattened endothelial cells of the intima are modified mesenchymal cells, as are also the smooth muscle-fibres of the media. The elastic plate of the intima and the fibres and elastic tissue of the adventitia are the same intercellular structures found in connective tissue.

Such structures as these are not classed ordinarily as connective tissue at all. In concluding this article, however, the writer wishes to emphasize the importance of the embryological aspect in understanding not only the histology of the various forms of connective tissue, but also their essential unity. *Ralph C. Larrabee.*

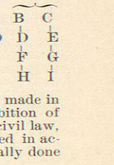
For bibliography, consult: Quain's Anatomy, vol. i., 1891, p. 243. C. S. Minot: Human Embryology, 1892. J. Disse: Das retikuläre Bindegewebe, in Ergebn. d. Anat. u. Entwickelungsgesch., Anat. Hefte, vii., 1897, p. 9.

CONSANGUINITY.—This term denotes blood relationship, and is to be distinguished from affinity, which signifies relationship by marriage. The husband bears the same relation to certain individuals by affinity that the wife bears by consanguinity. But two persons, each related to a third person by affinity, have thereby no affinity for each other.

The principal importance, from a medical point of view, of the subject of consanguinity is in the effect produced upon offspring by the fact of such a relation existing between the parents. In part from a belief in the injurious effects upon offspring of marriages between near kin, in part from the influence of authority, and in part from a natural repugnance to such unions, legal prohibitions have been placed in many countries upon marriages between persons who are within certain specified degrees of consanguinity. In some instances these restrictions have been extended from the field of consanguinity to that of affinity. In England, for example, for the past two hundred years it has been illegal for a man to marry his deceased wife's sister, a relation obviously not within the bounds of consanguinity at all.

Consanguinity may be either lineal or collateral. The former is reckoned between persons in the direct line of descent, either downward from progenitor to descendant, or upward from descendant to progenitor. Collateral consanguinity exists between two persons descended, not the one from the other, but both from some common ancestor. The degree of consanguinity is measured in the first instance by the number of generations separating the two individuals. Thus grandfather and grandchild are in the second degree of lineal or direct consanguinity. In defining the degree of collateral or indirect consanguinity two different methods have been used, which have given rise to some confusion. By the civil law the degree is measured by counting the number of generations upward from one individual to the common ancestor, and thence downward to the other. By the canon law the number of degrees are counted only in one line (that which is the longer of the two) from the common ancestor.

Thus, supposing F and G to be great-grandchildren of A, and hence second cousins, as by the accompanying diagram, according to the civil law they would be in the sixth degree of consanguinity, while by the canon law they would be in the third. The imperfectness of the latter mode of reckoning is shown by the fact that G would also be in the same degree of consanguinity, viz., the third, to A, B, and D; but in the fourth degree to H, the count then being made in the other, or longer line. Evidently, a prohibition of marriages within the third degree, made by the civil law, would become much more onerous if interpreted in accordance with the canon law. This was actually done by Pope Gregory I. (A.D. 590–604).



Much diversity has prevailed among different nations in their views concerning the marriage of kin. The traditions of the ancient mythologies, in their account, for instance, of the relations between Jupiter and Juno, and between Osiris and Isis, show that unions in the closest collateral degrees of consanguinity were not considered abhorrent. On the other hand, the story of (Œdipus and Jocasta indicates that marriages in the direct line of descent were looked upon as impious. The ancient Egyptians intermarried very closely, and in the history which we possess of the dynasty of the Ptolemies, a large proportion of the marriages are seen to be between brother and sister. In other nations of the East, notably among the Persians, marriage in the nearest degrees, even of direct consanguinity, prevailed. There is evidence that prior at least to the time of Moses this custom prevailed among the children of Israel. This very nation was descended from consanguineous unions. Abraham married his half-sister, Sarah, Isaac married Rebecca, his first cousin once removed, and Jacob his two first cousins, Rachel and Leah. Yet no one has ever questioned the vigor of the Israelites, who, in the first fourteen generations from their origin, became six hundred thousand fighting men. Indeed, a literal interpretation of the record in the Book of Genesis would indicate that the sons of Adam must have married their sisters, and that the whole human race is the product of a consanguineous marriage in the closest degree. The restrictions placed upon the marriage of relatives by the Mosaic law are worthy of special attention, because they have remained, to a great degree, in the usage of Christian nations in modern times. The following marriages were prohibited on the score of kinship by the Levitical law (Leviticus xviii.): That with a parent, or with a stepmother; with a sister, or half-sister; with a granddaughter; with an aunt, or an uncle's wife; with a son's wife; with a brother's wife; with a step-daughter, or a step-granddaughter; with a wife's sister, *during the lifetime* of the former. The Greeks, while forbidding marriages in the direct line of descent, permitted them be-

tween half-brothers and half-sisters; the Athenians allowing the marriages of brothers and sisters by the same father, but not of those by the same mother; and the Lacedæmonians, on the other hand, allowing uterine brothers and sisters to marry, but not those having a common father—an obviously arbitrary distinction.

The Romans held still stricter views. Not only the direct line of consanguinity, as well as brothers and sisters, either in whole or in half, were excluded from intermarriage, but any union within the degree of first cousin was practically illegal, the occasional marriage of uncles with nieces in the times of the Tarquins and of the emperors being held to be a stretch of despotic authority. The Institutes of Justinian, the basis of the modern civil law, forbade marriages in the direct line, and in the collateral line within the fourth degree. First cousins and all remoter kin might marry. The Roman Catholic Church extended the restrictions, discouraging, and then forbidding unions between first cousins. Various councils in the early centuries altered the rules, usually in the direction of greater exclusiveness. The present canon law, that of the fourth Lateran (twelfth general) Council, A.D. 1215, in force in most Roman Catholic countries, permits marriages only outside the fourth degree, *i.e.*, third cousins are forbidden to marry. The Church, however, reserves and exercises the power of allowing dispensation from this prohibition. The civil law permits marriage in the fourth (civil) degree, that is, allows first cousins to marry. The Greek Church allows third cousins to marry, but prohibits all nearer relations. In England the ecclesiastical prohibitions on this subject were at first even more stringent than those of the present canon law, but under Magna Charta they were modified so far as to admit marriage outside the fourth canonical degree.

The restrictions of the canon law were set aside in England by the Marriage Act of 1540, in the reign of Henry VIII., and the prohibitions of the civil law, practically the same as those of Leviticus, were substituted. Marriages may be made in the fourth and all remoter degrees, computed according to the civil law. Hence first cousins may marry, as may also nephew and great-aunt, or niece and great-uncle. Indeed, by the letter of the law, as has been pointed out, while a man may not marry his grandmother, he may marry her sister. This law affects England, Scotland, Ireland, and all the British colonies. It is worthy of remark in this connection that the prohibition of marriage with a deceased wife's sister, which is not Levitical, and which, in spite of an annual effort to remove it, is still maintained in the home country, has been removed in most of the British provinces.

In the various States of this country the degrees of consanguinity in which marriage is prohibited are practically those of the Levitical code. A few of the States, however, forbid by law the marriage of first cousins, and, on the other hand, in one or two, a man is allowed to wed his aunt or his niece.

The difficulties in the way of obtaining accurate knowledge as to the production of evil effects in offspring by consanguineous marriages are very great. In the first place, in the absence of State registration covering this point, people are apt to resent inquiries as impertinent. Especially is reluctance manifested if the children have any physical or mental defect. Secondly, upon persons who collect and record such cases among their own acquaintances, instances of evil results are liable to produce more effect than negative cases, which, presenting nothing of importance, drop out of notice, and the fact of consanguinity on the part of the parents is quite forgotten. Thirdly, in some of the unfavorable cases collected, too little attention is paid to the moral elements of the case. For instance, in the family of the Ptolemies, where the intermarriages were very close, whatever may be claimed as to the physical degeneracy of the stock (and there seems to be very little ground for Mr. Francis Galton's remark as to its sterility) may be in considerable degree ascribed to the enervating physical and moral effects of unlimited despotic power. Other tabulated lists prepared to show the evil effects on offspring of marriages between relatives include unions nearer than the fourth degree. But close incestuous unions presuppose moral degradation, and this cannot fail to have its effect on the physique both of parents and of children. Some of the figures collected upon this subject have been obtainable only from records of public institutions, and are based, for the most part, only on the lowest classes of society. But where, as in the individuals included in Dr. Howe's statistics, "most of the parents were intemperate," it would evidently be unfair to conclude that the large percentage of idiots among the children was due entirely to the consanguinity of the parents, and not in large part to their intemperance. Again, accounts have been published of certain European communities, geographically isolated, where numerous consanguineous marriages have occurred. Granting that there is no moral obliquity in these individuals, there is certainly very little ambition or enterprise in men who are content to stagnate in the same spot where their ancestors have lived for generations, with no curiosity to learn what lies outside the borders of their hamlets. Fourthly, confusion exists between the effects of consanguinity and those of hereditary morbific transmission. Where two relatives wed, both of whom possess a similar disease or tendency to disease, the offspring are very likely to inherit the disease, the latent tendency even becoming a patent actuality. But this is the fault of the morbific strain multiplied into itself, and thus raised, as it were, to its second power, and not of the mere fact of consanguinity in the parents. For the same result would follow the union of two persons not related if they possessed some defect in common; and, on the other hand, in the breeding of animals, while the parents are blood relations, yet such care is taken to select perfect specimens that no chance is allowed for the propagation of a fault. This point, which is of great importance, will be again alluded to later on. Fifthly, and finally, it should be remembered that positive cases in which the marriage of relatives has been found to give numerous and perfectly healthy children are more significant and important than negative instances, where perfect children did not follow such unions. Because in the latter case the imperfection may have been due to other elements than the consanguinity, whereas, if the fact of consanguinity in the parents constitutes *per se* an obstacle to the propagation of healthy children, defective offspring should follow in all or nearly all cases wherever that bar to perfect offspring, to wit, consanguinity, existed in the parents.

With the above provisos as to the interpretation of statistics bearing upon this point, we will now examine some of these reported facts.

Dr. Bemiss ("Repon on Influence of Marriages of Consanguinity upon Offspring," Transactions of the American Medical Association, 1858, vol. xi., p. 334) collected a large number of cases of marriage between relatives, which tell strongly against the safety of such unions. Eight hundred and thirty-three such marriages are reported, including cases of incest between parent and child, and brother and sister. The average number of births was 4.6. An extract from his table is given on the next page. This table presents the case against consanguineous marriages with its full strength. Yet, as the author himself says: "It is natural for contributors to overlook many of the more fortunate results of family intermarriage, and furnish those followed by defective offspring or sterility." One other vulnerable point in these figures presents itself. Marriages between third cousins are much more productive of evil results in the offspring than marriages between second or even first cousins! In other words, the eighth degree of consanguinity, which is so remote that persons occupying it must often be ignorant that any kinship at all exists, really constitutes a greater danger to marriage than relationship in the fourth degree.

Dr. Mitchell's statistics ("Memorandum before the Anthropological Society of London," vol. ii., 1866, p. 403), also classical upon this point, are based upon 45

Classes of Relationship.	Number of observations.	Average number of births.	Defective, per cent.	Deaf-mutes, per cent.	Blind, per cent.	Idiots, per cent.	Insane, per cent.	Epileptic, per cent.	Scrofulous, per cent.	Deformed, per cent.	Died young, per cent.
A. Incest with parent, or between brother and sister	10	3.10	93.5	....	....	61.2	....	3.2	16.1	35.4	....
B. With niece or aunt	12	4.42	75.4	1.9	5.6	5.6	1.9	1.9	39.7	26.4	43.3
C. With blood relations the issue of blood relations	56	4.18	53.8	4.2	5.1	12.8	1.2	1.7	18.8	3.8	26.9
D. With double first cousins	27	5.70	37.2	1.2	1.2	2.5	3.8	1.2	6.3	1.2	35.0
E. With first cousins	580	4.80	24.9	4.2	2.2	8.3	....	1.6	6.2	1.9	22.5
F. With second cousins	112	4.58	13.0	1.7	....	3.3	....	1.1	2.9	1.7	16.5
G. With third cousins	12	4.82	27.0	5.0	....	1.7	1.7	3.4	16.9	....	13.5
H. With first cousins, irregularly reported	24	5.00	17.5	2.5	....	2.5	1.6	....	12.5	....	10.0
Total	833	4.6	28.7	3.6	2.1	7.0	2.04	1.5	7.6	2.4	22.4
Compare marriages with persons in no way related	125	6.7	2.1	0.35	0.1	0.71	0.1	0.35	0.1	....	6.0

cases of consanguineous marriage. Eight couples were barren, and the remainder produced 146 children; an average of about 4 for each fertile marriage, or of 3 for all marriages, barren and fertile. Eight children were idiots, 5 imbecile, 11 insane, 2 epileptic, 4 paralytic, 2 deaf-mutes, 3 blind, 2 defective in vision, 3 deformed, 6 lame, 1 rachitic, 22 consumptive, scrofulous, or manifestly of weak constitution.

Dr. S. G. Howe's tables, computed from Massachusetts statistics (*Journal of Psychological Medicine and Mental Pathology*, July, 1858), have been already referred to. These marriages produced 95 children, an average of 5.5 each. Forty-four were idiots, 12 scrofulous, 1 deaf, and 1 a dwarf.

Huth, in the appendix of his work ("The Marriage of Near Kin"), from which some of the above observations have been taken, has gathered a series of 299 cases from many sources, a considerable portion being from writers who disapprove of consanguineous marriages. The catalogue of diseases referred to this cause is long, numbering nearly forty. The total children born were at least 1,155 (3.8 per marriage), and in 83 of the families there were no unhealthy children.

It will thus be seen that those who condemn consanguineous marriages *ipso facto* have presented a very extensive catalogue of charges. Those most generally dwelt upon have had relation to what may be called the social functions of the individual. As Guipon, representing this opinion, puts it (*Comptes Rendus*, vol. lvii., p. 513), "consanguinity exerts a depressing effect on the vital forces, notably upon reproduction, so that if sterility is not observed in consanguineous marriages themselves, it at least shows itself in their children. It affects the functions of relation and the organs of sense, hearing, speech, and sight. The genital sense is exalted, but its natural end and aim is thwarted."

On the other hand, numerous and reputable observers have reported many cases where consanguineous marriages were unattended by any degenerative conditions in the offspring. For example, we have an instance reported by M. Dally (*Anthrop. Review*, May, 1884, p. 95), where two families continually intermarried for five generations, no marriage being in a more distant degree than first cousins, except two of second cousins. The total number of branches direct and collateral was 120 to 140. There was not a single case of deaf-mutism or idiocy, but there were 2 cases of consumption, 1 "caused by a cold," and 1 case of senile insanity in a woman of sixty-eight. It should be remarked that there was no predisposition to disease in the family.

Perhaps the most striking instance on record of consanguineous marriages without ill effect upon offspring is furnished by M. Bourgeois (*Comptes Rendus*, vol. lvi., p. 178). The family in question is his own. A genealogical table is given covering seven generations. In one branch of the family, of five successive generations four married their cousins, and the offspring of the fourth successive consanguineous marriage consisted of six children all perfectly healthy save one, who is defective mentally—a defect, however, ascribable to an accidental traumatic injury. The founder of the race himself married a kinswoman, and among the descendants seven others have married cousins. Indeed, of the sixty-eight unions that have occurred, all feeling more or less the influence of consanguinity, but one has been infertile, and that infertility was due to disease of the mother, who was an alien; on the husband's side, moreover, it was necessary to ascend three generations to reach the first union of cousins. Among the two hundred individuals of this remarkably inbred family, all are very healthy, except the children of one of the latest marriages, in some of whom a tuberculous taint has appeared.

M. Voisin collected some observations bearing strongly on the favorable side of consanguineous marriages. In the commune of Batz, in Brittany, was a population of 3,300 souls, quite isolated from the rest of the department. In 1864, M. Voisin found in that community 5 marriages between cousins-german, 31 between cousins of the next degree below, and 10 between cousins of the degree after that. The first class produced 23 children free from all constitutional disease, 2 only having died of casual disorders. The 31 marriages of second cousins produced 120 children, all free of constitutional taint, 24 dying of acute disorders. The 10 marriages of third cousins gave 29 healthy children, of whom 3 died of accidental diseases. Sterility occurred in only two families, the parents being related to each other in the third degree (canonical). Mental disorders, idiocy, deaf-mutism, and hemeralopia were all unknown. The general health of the population was good.

The same author states, as the result of a careful examination of 1,077 of his patients at the Bicêtre and Salpétrière hospitals, that in no one instance of his idiotic, epileptic, or insane patients could healthy consanguinity be legitimately regarded as the cause of the affection.

M. Seguin gives the result (*Comptes Rendus*, vol. lvii., 1863, p. 253) of ten consanguineous marriages occurring in his own family. One marriage was barren, but the average children in each of the ten marriages was over six. There was not a single case of deaf-mutism, hydrocephalus, impediment of speech, or supernumerary digits among all the children.

One great difficulty has been, in considering the returns of defective children born from consanguineous marriages, that we have no means of knowing what the proportion of consanguineous marriages themselves is. Until this latter element is learned we cannot tell whether the defective children of relatives are or are not numerous out of proportion to the children of the non-related. It is very desirable, therefore, that by some authority, like that of the census, the number of consanguineous marriages be ascertained. This, unfortunately, has never been done. A formal request to this effect was made by a scientific body of the director of the Eleventh United States Census, but was denied.

Mr. George H. Darwin, however, has collected some valuable and novel observations upon this point (*Journal of the Statistical Society of London*, July, 1875; also, *Fortnightly Review*, July, 1875).

This writer, by means of ingenious computations which space is insufficient to allow of giving in detail, concludes that in London, comprising all classes, the

first-cousin marriages are about 1¼ per cent. of all marriages; in the urban districts, 2 per cent.; in the rural districts, 2¼ per cent.; in the middle and upper middle class, or in the landed gentry, 3½ per cent.; and in the aristocracy, probably 4½ per cent.

Mr. Darwin then collected returns from a number of lunatic and idiotic asylums regarding the proportion of the inmates who were the offspring of consanguineous marriages, and found that where the figures obtained were most reliable, the proportion exceeded but slightly, if at all, the ratio of first-cousin marriages in the country at large, being from three to four per cent. Among deaf-mutes, also, the offspring of first-cousin marriages was almost exactly the same as the proportion of such marriages for the town and country.

Regarding the fertility of first-cousin marriages and of the descendants of such marriages, against which Professor Mantegazza, M. Boudin, and others have pronounced, Mr. Darwin finds, from figures obtained from "Burke's Landed Gentry" and the "Peerage," that the fertility, as shown by the number of sons surviving infancy, is somewhat greater in marriages of first cousins, and where one of the parents was the child of a first-cousin marriage, than when the parents were not consanguineous, the average number of sons in each of these three classes being respectively 1.92 to 2.07, 1.93, and 1.91. As to the youthful death rate, the evidence, from the small number of families (37) for which these data existed (all from the peerage), gave a slightly increased death rate in early years for the children of consanguineous parents.

While admitting a certain amount of truth in the popular sentiment in regard to the evil effects upon offspring of marriages of kin, Mr. Darwin holds that the evil has been much exaggerated.

The writer of the present article collected a series of cases of consanguineous marriages, whose results were embodied in a paper read before the Massachusetts Medical Society, June, 1885, and published in its "Proceedings" for that year. In 108 such unions 103 were fertile, producing 413 children. Excluding from the category of the "healthy" all who had any physical defect, including even polydactylism and strabismus, all who were below the average in mental or bodily vigor, all who developed phthisis or any other constitutional taint, even though it did not appear till late in life, and all who died in infancy, except when the death was known to be from some acute malady, 312 of the children, being 75½ per cent. of the whole number, were classed as healthy. The principal diseases and defects comprised 12 cases of deaf-mutism (all occurring in a small isolated community on the island of Martha's Vineyard), 7 of insanity, 13 of idiocy, and 15 of consumption. The fertility of all of the unions which were known to have lasted twenty-five years or over, 57 in number, was on an average 5 children to each couple.

There were 17 consecutive consanguineous marriages, *i.e.*, those in which one or both the parties marrying in kinship were themselves descended from a similar union. Of these marriages only 9 had lasted the whole child-bearing period, and these produced 50 children. In all, from the 17 marriages, 15 being fertile, 68 children were born, of whom 48 were "healthy."

There were also 128 marriages not consanguineous, but to which one or both of the parties were descended from persons related. Some of the marriages had lasted but a short time; but 110, or 86 per cent., had already proved fertile, with at least 372 children, and probably many more. Only 47 of the unions were known to have lasted twenty-five years or over, and these produced 240 children.

An analogy of considerable significance to the question of consanguineous unions in the human subject is to be drawn from the so-called in-and-in breeding of animals. Bakewell, the brothers Collings, and Bates, in England, were the first to advocate and practise incestuous breeding among cattle. The Leicester breed of sheep and a breed of long-horned cattle were created by Bakewell on this plan, and with a good measure of success. The "Duchess" short-horned cattle, produced by Bates in the same manner, were also famous for a time, but have now become nearly extinct. Cattle breeders at the present time are divided in opinion as to the advantages of thorough in-and-in breeding, some claiming that this method in time will impair the fertility of the stock, and pointing for proof of this to the numerical deterioration of some of the breeds first formed on this plan. Their opponents say, on the other hand, that as long as Bakewell himself lived to give the benefit of his judgment to the selection of the individuals to be bred from, the stock retained its excellence. Moreover, there are numerous examples to be adduced in which incestuous breeding has succeeded in not only developing, but perpetuating a breed for long periods. M. Beaudouin tells (*Comptes Rendus*, August 5th, 1882) of having inbred merino sheep very closely for twenty-two years without in any degree diminishing their fertility. The "Jersey" cattle have for one hundred and fifty years been bred on a small island only six miles by eleven (no larger than a western ranch), with no intermixture of foreign blood; yet, when first known to the outside world they were already an established breed, noted not only for their excellence as butter-makers, but for their beauty, docility, and intelligence. The early importations of these cattle to this country were, of necessity, very closely inbred. Indeed, some of the most striking instances of in-and-in breeding on record are among Jersey cattle. Take, for instance, the St. Helier strain. This bull was put successively to his daughter and granddaughter, and by the latter begot a son (Oxoli), which was also a great-grandson, and a daughter (Chromatella), which was also his great-granddaughter. Each of these animals had 87½ per cent. of the blood of their great-grandsire (seventy-five per cent. more than has a child by a non-consanguineous union). Chromatella was bred to the son of her brother Oxoli, and dropped two daughters, both healthy and good breeders. Oxoli also bred to three daughters of St. Helier (having fifty per cent. of the latter's blood), one of them being his own (Oxoli's) granddam. He also bred to several cows having seventy-five per cent. of the blood of St. Helier, of which he himself had 87½ per cent. In fact, the history of this strain shows a large number of unions of the very closest possible nature, a great majority of the descendants having more than fifty per cent. of the blood of their progenitor. Yet for excellence not only of the butter record, but of general health, and for fertility, the strain is most remarkable. Again, the bull Favorite, himself highly inbred, was put successively to his daughter, daughter's daughter, and daughter's daughter's daughter, he being the sire in each case. The result of this last union was a cow having 93¾ per cent. of the blood of Favorite, and the mother of some of the most remarkable animals known.

Among racing horses "Rysdyk's Hambletonian" may be mentioned as an example of a closely inbred horse. Yet it is stated on good authority that during the year 1883, among 190 new performers that entered the list of 2.30 trotters, 41 per cent. were by Rysdyk's Hambletonian, his sons and grandsons; while 20 per cent. of the residue were more or less closely related to Hambletonian.

It is important to bear in mind that what is called "in-and-in breeding" among cattle breeders, means a closeness of mating which is not only out of the question in the human subject on ethical considerations, but is far beyond the bounds of physical possibility. In mankind, a marriage between first cousins would give the offspring but twenty-five per cent. of the blood of the common ancestor of the parents. The child of parents who are uncle and niece will have thirty-seven per cent. of the blood of the common ancestor; and even the product of the union of brother and sister will have but fifty per cent. of the blood of one of its grandparents. In other words, unions equivalent in closeness to the nearest consanguineous marriages made among men are not considered by cattle-breeders worthy the name "in-and-in" at all. Mr. Campbell Brown, speaking (as a disbeliever

in incestuous breeding) of a horse that had been claimed as closely inbred, says "that he had only twenty-five per cent. of the blood of a certain other stallion," and adds "that that is a degree of inbreeding to which there can hardly be rational objection." Yet this is just the per cent. which the child of first cousins has in the blood of their common ancestor.

In comparisons between the results of in-breeding in animals and in man, we are to remember of course that in the former case there is a studied selection of the qualities in the individuals to be mated, while in the union of human beings affection is usually the only guide.

In estimating, however, the effect of consanguinity pure and simple as an element in the determination of offspring, it is proper to take it where it is free from all possible complication by inherited morbid influences. If cattle breeders, in their endeavors to perpetuate a fine breed by the principles of natural selection, can win success out of in-breeding, it follows that there is nothing in the fact of consanguinity itself in parents which of necessity deteriorates the offspring. When, therefore, it is objected that human consanguineous marriages should not be compared to in-and-in breeding among animals, for the reason that in the former the principles of natural selection are not observed as they are in the latter, it may be answered that what is the same in the two classes of animal is unions of kindred, and that it is those similar conditions only which it is sought to compare. It is not denied that "like produces like," whether of bad or of good, and if a union of two imperfect individuals of allied blood produces diseased or defective offspring, it is in obedience to a law of nature too universal to be affected in any way by the accident of consanguinity.

The objection has also been made that the product of in-and-in breeding is not a perfect animal, but is, as Dr. Mitchell has expressed it, "a saleable defect," a "perfect pathological specimen," less useful to himself if he were to be left to himself and deprived of artificial care and keeping than the natural animal would be under like circumstances. Here again the influence of consanguinity has been confounded with that of natural selection. In accordance with the latter principle, any quality may be selected as the aim of breeding—as speed or strength in the horse; milk, draught, or flesh in cattle; wool or fat in sheep, etc. According to the point of view of the observer will the product of such breeding be intrinsically beautiful and valuable, or the reverse. A breed of pigs may be produced so fat that they cannot stand, and certainly "less useful to themselves" than in a natural state. Yet we have it on the best authority that no horse bears fatigue so well, or recovers from its effects so soon, as the thoroughbred. "Indeed," says an eminent hunting authority, "there is scarcely a limit to the work of full-bred hunters of good form, constitution, and temper." The argument that the thoroughbred animal is less "useful to himself," because he has become dependent on artificial conditions of food and shelter, would prove equally well that civilized man is inferior to the aborigines.

Deaf-mutism is a defect which has been said to bear a special relation to marriages of near kin. This general impression is doubtless due to the undeniable frequency of deafness among the children of unions where one and especially where both of the parties are deaf. This liability is greatly enhanced if the deafness of the parents is congenital, or if either of them has deaf relatives. On this ground Professor Bell has urgently advised that deaf-mutes, if they marry, should select hearing persons and those too, only, who have no deaf relatives. He says that a deaf person (not born deaf) who has no deaf relatives will not increase the liability to deaf offspring by marrying a blood relation; but a congenital deaf-mute under the same conditions he thinks will. While a deaf person, so born or not, who has deaf relations will especially increase this liability in the offspring if he marries a relative on the same side of his family in which other cases of deafness have occurred.

Boudin asserted that deaf-mutism was specially selected by Providence as the punishment for the violation of "nature's law" involved in consanguineous marriages, in order that man, as the "talking animal," may bear the brunt of the penalty! But Dr. Child has shown that deaf-mutism is simply a congenital deafness to which mutism has succeeded because the individual cannot hear himself speak, and that the same defect, congenital deafness, may and does exist in the lower animals. Indeed, the whole drift of modern science is against such attempted distinctions. Man is physiologically an animal, and in the manner of his propagation is subject to the same laws as any other animal. If, then, as seems to be the case, analogies drawn from the lower animals show that even "in-and-in breeding," in the hands of practical men working for pecuniary returns, gives good results in the form, usefulness, and fertility of their stock, it is a fair inference that at least the occasional admixture of a comparatively small amount of kindred blood, involved for instance in a marriage of cousins, is innocuous in the human species.

How, then, shall we reconcile the above conclusions with figures such as those published by Bemiss, Howe, Mitchell, and Boudin? Have no unfortunate results been found from consanguineous unions? Undoubtedly; but such results have followed for the most part, and probably exclusively, where consanguineous marriages have intensified morbid characteristics of both parents. Such unions may transmit and intensify admirable attributes as well as undesirable ones. Children have a tendency to revert to a common ancestor. If the common ancestor of both parents is not a remote one (by reason of their consanguinity), the type to which the child reverts is not the common type of the race, but is that of this comparatively recent ancestor, say, a grandfather. Should that ancestor possess exceptionally desirable qualities, the child stands a chance to be above the average of its fellows. But if this common progenitor has a depraved or diseased quality of mind or body, it is more likely to find expression in the child inheriting from him in two lines, than in that inheriting from him only in one. Because any newly acquired taint in an individual is much less likely to lose itself in his descendants if diluted in an extraneous strain than if intensified by being multiplied into itself, and so going on in a sort of geometrical increase.

It must be admitted that many families do possess physical and mental traits whose perpetuation would be undesirable. And it is this fact which lends whatever danger there is to consanguineous marriages. It is perfectly true that what has been called "social consanguinity" in marriage is open to much the same objections as true consanguinity. If marriages are constantly contracted within the same locality and social environment, the resultant offspring may become as eccentric mentally and feeble physically. Certain royal families have suffered perhaps as much from the lack of this social dilution as from anything else short of the actual in-breeding of disease.

To conclude, a danger exists to the offspring of related parents if these parents are sharers in any family disease or tendency thereto, and not otherwise.

Charles F. Withington.

CONSCIOUSNESS, DISORDERS OF THE.—In any discussion, having for its object the setting forth of some aspects of the subject of "Disorders of Consciousness," it is desirable that certain features of normal consciousness should be presented, and yet from the very complexity of this latter subject such a preliminary for the present purposes might seem fruitless.

In the present exposition it is assumed that it is not known what consciousness is: one is cognizant only of what one feels at any particular moment. Reasoning along such lines many modern psychologists assume the "stream-like character of consciousness," with its continuous flow; the moment's consciousness being in focus as the stream goes by. This moment's consciousness is made up dimly of the apperceptions of things about to come into consciousness and faintly fringed about with