

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN NOVEMBER.

- Nov. 2. 2h. 55m. to 6h. 8m. Transit of Jupiter's Sat. III.
- 3. 9h. 33m. Minimum of Algol (β Persei).
- 3. 12h. 4m. to 12h. 30m. Moon occults ω Leonis (mag. 5.6).
- 6. 6h. 22m. Minimum of Algol (β Persei).
- 9. 7h. 13m. Transit (ingress) of Jupiter's Sat. III.
- 10. Annular eclipse of the sun, invisible at Greenwich.
- 14-15. Epoch of Leonid meteoric shower (radiant $150^{\circ} + 22^{\circ}$).
- 15. 8h. Jupiter in conjunction with moon. Jupiter $4^{\circ} 44' S.$
- 15. 10h. Saturn in conjunction with moon. Saturn $4^{\circ} 21' S.$
- 15. Venus. Illuminated portion of disc = 0.591, of Mars = 0.967.
- 17. 18h. Venus in conjunction with Jupiter. Venus $2^{\circ} 45' S.$
- 18. 19h. Venus in conjunction with Saturn. Venus $3^{\circ} 12' S.$
- 20. 17h. Mercury at greatest elongation west, $19^{\circ} 42'.$
- 23. 11h. 15m. Minimum of Algol (β Persei).
- 24. Epoch of Andromedid meteoric shower (radiant $24^{\circ} + 43^{\circ}$).
- 25. 8h. 11m. to 9h. 0m. Moon occults B.A.C. 1240 (mag. 5.7).
- 25. 17h. 14m. to 18h. 7m. Moon occults D.M. + 18° , 624 (mag. 5.9).
- 26. 8h. 4m. Minimum of Algol (β Persei).
- 27. 10h. 41m. to 10h. 54m. Moon occults γ Orionis (mag. 5.1).
- 27. 18h. Jupiter in conjunction with Saturn. Jupiter $0^{\circ} 27' S.$
- 28. 19h. 18m. to 20h. 6m. Moon occults 68 Geminorum (mag. 5.0).
- 30. 9h. 54m. to 10h. 24m. Moon occults κ Cancri (mag. 5.0).

PERIOD OF MIKA (α CETI).—In the *Astronomische Nachrichten* (Bd. 157, No. 3745), Herr P. Guthnick classifies many of the available observations of this star, and from them deduces a mean value of the period. Sets of specially bright or faint maxima and minima are grouped together, the frequent long gaps, however, making the detailed form of the light curve somewhat uncertain. The minima may be determined from the formula

$$1883 \text{ January } 12^{\circ}09 + 331d^{\circ}3359 \text{ E.}$$

An ephemeris is given showing the predicted times of maxima and minima for the next twenty years.

Maxima		Minima	
1901 July	9.0	1901 March	5.8
1904 March	30.2	1902 Jan.	31.1
1905 Feb.	25.0	1902 Dec.	28.5
1906 Jan.	22.4	1903 Nov.	24.8
1906 Dec.	19.6	1904 Oct.	21.2
		1905 Sept.	17.5
		1906 Aug.	14.8

THE POSSIBLE IMPROVEMENT OF THE HUMAN BREED UNDER THE EXISTING CONDITIONS OF LAW AND SENTIMENT.¹

IN fulfilling the honourable charge that has been entrusted to me of delivering the Huxley lecture, I shall endeavour to carry out what I understand to have been the wish of its founders, namely, to treat broadly some new topic belonging to a class in which Huxley himself would have felt a keen interest, rather than to expatiate on his character and the work of his noble life.

That which I have selected for to-night is one which has occupied my thoughts for many years, and to which a large part of my published inquiries have borne a direct though silent reference. Indeed, the remarks I am about to make would serve as an additional chapter to my books on "Hereditary Genius" and on

¹ The second Huxley Lecture of the Anthropological Institute, delivered by Francis Galton, D.C.L., D.Sc., F.R.S., on October 29, 1901.

"Natural Inheritance." My subject will be the possible improvement of the human race under the existing conditions of law and sentiment. It has not hitherto been approached along the ways that recent knowledge has laid open, and it occupies in consequence a less dignified position in scientific estimation than it might. It is smiled at as most desirable in itself and possibly worthy of academic discussion, but absolutely out of the question as a practical problem. My aim in this lecture is to show cause for a different opinion. Indeed I hope to induce anthropologists to regard human improvement as a subject that should be kept openly and squarely in view, not only on account of its transcendent importance, but also because it affords excellent but neglected fields for investigation. I shall show that our knowledge is already sufficient to justify the pursuit of this perhaps the grandest of all objects, but that we know less of the conditions upon which success depends than we might and ought to ascertain. The limits of our knowledge and of our ignorance will become clearer as we proceed.

Human Variety.—The natural character and faculties of human beings differ at least as widely as those of the domesticated animals, such as dogs and horses, with whom we are familiar. In disposition some are gentle and good-tempered, others surly and vicious; some are courageous, others timid; some are eager, others sluggish; some have large powers of endurance, others are quickly fatigued; some are muscular and powerful, others are weak; some are intelligent, others stupid; some have tenacious memories of places and persons, others frequently stray and are slow at recognising. The number and variety of aptitudes, especially in dogs, is truly remarkable; among the most notable being the tendency to herd sheep, to point and to retrieve. So it is with the various natural qualities that go towards the making of civic worth in man. Whether it be in character, disposition, energy, intellect, or physical power, we each receive at our birth a definite endowment, allegorised by the parable related in St. Matthew, some receiving many talents, others few; but each person being responsible for the profitable use of that which has been entrusted to him.

Distribution of Qualities in a Nation.—Experience shows that while talents are distributed in endless different degrees, the frequency of those different degrees follows certain statistical laws, of which the best known is the Normal Law of Frequency. This is the result whenever variations are due to the combined action of many small and different causes, whatever may be the causes and whatever the object in which the variations occur, just as twice 2 always makes 4, whatever the objects may be. It therefore holds true with approximate precision for variables of totally different sorts, as, for instance, stature of man, errors made by astronomers in judging minute intervals of time, bullet marks around the bull's-eye in target practice, and differences of marks gained by candidates at competitive examinations. There is no mystery about the fundamental principles of this abstract law; it rests on such simple fundamental conceptions as, that if we toss two pence in the air they will, in the long run, come down one head and one tail twice as often as both heads or both tails. I will assume then, that the talents, so to speak, that go to the formation of civic worth are distributed with rough approximation according to this familiar law. In doing so, I in no way disregard the admirable work of Prof. Karl Pearson on the distribution of qualities, for which he was adjudged the Darwin Medal of the Royal Society a few years ago. He has amply proved that we must not blindly trust the Normal Law of Frequency; in fact, that when variations are minutely studied they rarely fall into that perfect symmetry about the mean value which is one of its consequences. Nevertheless, my conscience is clear in using this law in the way I am about to. I say that if certain qualities vary normally, such and such will be the results; that these qualities are of a class that are found, whenever they have been tested, to vary normally to a fair degree of approximation, and consequently we may infer that our results are trustworthy indications of real facts.

A talent is a sum whose exact value few of us care to know, although we all appreciate the inner sense of the beautiful parable. I will, therefore, venture to adapt the phraseology of the allegory to my present purpose by substituting for "talent" the words "normal-talent." The value of this normal talent in respect to each and any specified quality or faculty is such that one-quarter of the people receive for their respective shares more than one normal-talent over and above the average of all the shares. Our normal-talent is therefore identical with what is technically known as the "probable error." Therefore the

whole of the following table starts into life, evolved from that of the "probability integral." It expresses the distribution of

TABLE I.—Normal Distribution (to the nearest per ten-thousand and to the nearest per hundred).

	-4°	-3°	-2°	-1°	M	+1°	+2°	+3°	+4°	Total
<i>v</i> and below	<i>u</i>	<i>t</i>	<i>s</i>	<i>r</i>	R	S	T	U	<i>V</i> and above.	
	35	180	672	1613	2500	2500	1613	672	180	35
	2	7	16	25	25	16	7	2		
										10,000
										100

any normal quality, or any group of normal qualities, among 10,000 persons in terms of the normal-talent. The M in the upper line occupies the position of Mediocrity, or that of the average of what all have received: the + 1°, + 2°, etc., and the - 1°, - 2°, etc., refer to normal talents. These numerals stand as graduations at the heads of the vertical lines by which the table is divided. The entries between the divisions are the numbers per 10,000 of those who receive sums between the amounts specified by those divisions. Thus, by the hypothesis, 2500 receive more than M but less than M + 1°, 1613 receive more than M + 1° but less than M + 2°, and so on. The terminals have only an inner limit, thus 35 receive more than 4°, some to perhaps a very large but indefinite amount. The divisions might have been carried much farther, but the numbers in the classes between them would become less and less trustworthy. The left half of the series exactly reflects the right half. As it will be useful henceforth to distinguish these classes, I have used the *capital* or large letters R, S, T, U, V, for those above mediocrity and corresponding *italic* or small letters, *r, s, t, u, v,* for those below mediocrity, *r* being the counterpart of R, *s* of S, and so on.

In the lowest line the same values are given, but more roughly, to the nearest whole percentage.

It will assist in comprehending the values of different grades of civic worth to compare them with the corresponding grades of adult male stature in our nation. I will take the figures from my "Natural Inheritance," premising that the distribution of stature in various peoples has been well investigated and shown to be closely normal. The average height of the adult males, to whom my figures refer, was nearly 5 feet 8 inches, and the value of their "normal-talent" (which is a measure of

the spread of distribution) was very nearly 1½ inches. From these data it is easily reckoned that Class U would contain men whose heights exceed 6 feet 1½ inches. Even they are tall enough to overlook a hatless mob, while the higher classes, such as V, W and X, tower above it in an increasingly marked degree. So the civic worth (however that term may be defined) of U-class men, and still more of V-class, are notably superior to the crowd, though they are far below the heroic order. The rarity of a V-class man in each specified quality or group of qualities is as 35 in 10,000, or say, for the convenience of using round numbers, as 1 to 300. A man of the W class is ten times rarer, and of the X class rarer still; but I shall avoid giving any more exact definition of X than as a value considerably rarer than V. This gives a general but just idea of the distribution throughout a population of each and every quality taken separately so far as it is normally distributed. As already mentioned, it does the same for any group of normal qualities; thus, if marks for classics and for mathematics were severally normal in their distribution, the combined marks gained by each candidate in both those subjects would be distributed normally also, this being one of the many interesting properties of the law of frequency.

Comparison of the Normal Classes with those of Mr. Booth.—Let us now compare the normal classes with those into which Mr. Charles Booth has divided the population of all London, in a way that corresponds not unfairly with the ordinary conception of grades of civic worth. He reckons them from the lowest upwards, and gives the numbers in each class for East London. Afterwards he treats all London in a similar manner, except that sometimes he combines two classes into one and gives the joint result. For my present purpose, I had to couple them somewhat differently, first disentangling them as I best could. There seemed no better way of doing this than by assigning to the members of each couplet the same proportions that they had in East London. Though this was certainly not accurate, it is probably not far wrong. Mr. Booth has taken unheard-of pains in this great work of his to arrive at accurate results, but he emphatically says that his classes cannot be separated sharply from one another. On the contrary, their frontiers blend, and this justifies me in taking slight liberties with his figures. His class A consists of criminals, semi-criminals, loafers and some others, who are in number at the rate of 1 per cent. in all London—that is 100 per 10,000, or nearly three times as many as the *v* class: they therefore include the whole of *v* and spread upwards into the *u*. His class B consists of very poor persons who subsist on casual earnings, many of whom are inevitably poor from shiftlessness, idleness or drink. The numbers in this and the A class combined closely correspond with those in *t* and all below *t*.

TABLE II.—Comparison of Mr. Booth's Classification of All London with the Normal Classes.

Nos.	Mr. Booth's classes.	Approx	Resorted.	Approx.	Nos.	Normal classes.
97	H. All above G	100	100	100	89	T and above
200	{ G. Lower middle } { F. High-class labour above 30s. per week }	200	{ 150 } { 50 }	150	161	S
382	E. Regular standard earnings from 22s. to 30s. per week	400	{ 200 } { 200 }	250	250	R
227	{ D. Regular earnings under 22s. per week } { C. Intermittent earnings, improvident, poor }	200	{ 50 } { 150 }	250	250	<i>r</i>
94	{ B. Casual; very poor } { A. Criminals, loafers, &c. }	100	100	100	89	<i>t</i> and below

1000

1000

1000

1000

The two columns headed "Nos." give respectively the numbers per thousand in Mr. Booth's and in the normal classes.

above," to the nearest ten-thousandth. They may be read either as applying to fathers and their sons when adult, or to mothers and their daughters when adult, or, again, to parent-ages and filial couplets. I will not now attempt to explain the details of the calculation to those to whom these methods are new. Those who are familiar with them will easily understand the exact process from what follows. There are three points of reference in a scheme of descent which may be respectively named "mid-parental," "genetic" and "filial" centres. In the present case of both parents being alike, the position of the mid-parental centre is identical with that of either parent separately. The position of the filial

are directed towards the same point below, but are stopped at one-third of the distance on the way to it. The contents of each parental class are supposed to be concentrated at the foot of the median axis of that class, this being the vertical line that divides its contents into equal parts. Its position is approximately, but not exactly, half-way between the divisions that bound it, and is as easily calculated for the extreme classes, which have no outer terminals, as for any of the others. These median points are respectively taken to be the positions of the parental centres of the whole of each of the classes; therefore the positions attained by the converging lines that proceed from them at the points where they are stopped, represent the genetic

STANDARD SCHEME OF DESCENT

PARENTAL GRADES NUMBER IN EACH	U	t	S	T	R	S	T	U
	22	67	161	250	250	161	67	22
1000 COUPLES BOTH PARENTS OF SAME GRADE AND ONE ADULT CHILD TO EACH	[Diagram showing 1000 couples distribution]							
REGRESSION OF PARENTAL TO FILIAL CENTRES	[Diagram showing regression lines]							
22 CHILDREN OF U	6	8	6	2				
67 " OF t	7	17	23	15	4			
161 " OF S	5	22	50	52	25	6		1
250 " OF T	2	14	51	86	68	25		4
250 " OF R		4	25	68	86	51	14	2
161 " OF S			1	6	25	52	50	22
67 " OF T				1	4	15	23	17
22 " OF U						2	6	8
SUMS	20	66	162	252	252	162	66	20

centres. From these the filials disperse to the right and left with a "spread" that can be shown to be three-quarters that of the parentages. Calculation easily determines the number of the filials that fall into the class in which the filial centre is situated, and of those that spread into the classes on each side. When the parental contributions from all the classes to each filial class are added together they will express the distribution of the quality among the whole of the offspring. Now it will be observed in the table that the numbers in the classes of the offspring are identical with those of the parents, when they are reckoned to the nearest whole percentage, as should be the case according to the hypothesis. Had the classes been narrower and more numerous, and if the calculations had been carried on to two more places of decimals, the correspondence would have been identical to the nearest ten-thousandth. It was unnecessary to take the trouble of doing this, as the table affords a sufficient basis for what I am about to say. Though it does not profess to be more than approximately true in detail, it is certainly trustworthy in its general form, including as it does the effects of regression, filial dispersion, and the equation that connects a parental generation with a filial one when they are statistically alike. Minor corrections will be hereafter required, and can be applied when we have a better knowledge of the material. In the meantime it will serve as a standard table of descent from each generation of a people to its successor.

Economy of Effort.—I shall now use the table to show the economy of concentrating our attention upon the highest classes. We will therefore trace the origin of the V class—which is the highest in the table. Of its 34 or 35 sons, 6 come from V parentages, 10 from U, 10 from T, 5 from S, 3 from R, and none from any class below R. But the numbers of the contributing parent-ages have also to be taken into account. When this is done, we see that the lower classes make their scores owing to their quantity and not to their quality; for while 35 V-class parents suffice to produce 6 sons of the V class, it takes 2500 R-class fathers to produce 3 of them.

centre is that from which the children disperse. The genetic centre occupies the same position in the parental series that the filial centre does in the filial series. "Natural Inheritance" contains abundant proof, both observational and theoretical, that the genetic centre is not and cannot be identical with the parental centre, but is always more mediocre, owing to the combination of ancestral influences—which are generally mediocre—with the purely parental ones. It also shows that the regression from the parental to the genetic centre, in the case of stature at least, would amount to two-thirds under the conditions we are now supposing. The regression is indicated in the diagram by converging lines which

Consequently the richness in produce of V-class parentages is to that of the R-class in an inverse ratio, or as 143 to 1. Similarly, the richness in produce of V-class children from parentages of the classes U, T, S, respectively, is as 3, 11½ and 55; to 1. Moreover, nearly one-half of the produce of V-class parentages are V or U taken together, and nearly three-quarters of them are either V, U or T. If then we desire to increase the output of V-class offspring, by far the most profitable parents to work upon would be those of the V class, and in a threefold less degree those of the U class.

When both parents are of the V class the quality of parent-ages is greatly superior to those in which only one parent is a

V. In that case the regression of the genetic centre goes twice as far back towards mediocrity, and the spread of the distribution among filials becomes nine-tenths of that among the parents, instead of being only three-quarters. The effect is shown in Table IV.

TABLE IV.—Distribution of Sons. (1) One parent of class V., the other unknown. (2) Both parents of class V (from Table II., with decimal point and an o).

	Distribution of Sons								Total
	t	s	r	R	S	T	U	V	
One V-parent ...	0.3	1.2	3.5	7.9	9.6	7.5	3.6	1.3	34.3
Two V-parents				3.0	5.0	10.0	10.0	6.0	34.0

Position of the filial centre of (1) = 1.44, of (2) = 2.89. When both parents are T it = 1.58.

There is a difference of fully two divisions in the position of the genetic centre, that of the single V parentage being only a trifle nearer mediocrity than that of the double T. Hence it would be bad economy to spend much effort in furthering marriages with a high class on only one side.

Marriage of Like to Like.—In each class of society there is a strong tendency to intermarriage, which produces a marked effect in the richness of brain power of the more cultured families. It produces a still more marked effect of another kind at the lowest step of the social scale, as will be painfully evident from the following extracts from the work of Mr. C. Booth (i. 38), which refer to his Class A, who form, as has been said, the lowermost third of our "v and below." "Their life is the life of savages, with vicissitudes of extreme hardship and occasional excess. From them come the battered figures who slouch through the streets and play the beggar or the bully. They render no useful service, they create no wealth; more often they destroy it. They degrade whatever they touch, and as individuals are perhaps incapable of improvement . . . but I do not mean to say that there are not individuals of every sort to be found in the mass. Those who are able to wash the mud may find some gems in it. There are at any rate many very piteous cases. Whatever doubt there may be as to the exact numbers of this class, it is certain that they bear a very small proportion to the rest of the population, or even to Class B, with which they are mixed up and from which it is at times difficult to separate them. . . . They are barbarians, but they are a handful. . . ." He says further, "It is much to be desired and to be hoped that this class may become less hereditary in its character; there appears to be no doubt that it is now hereditary to a very considerable extent."

Many who are familiar with the habits of these people do not hesitate to say that it would be an economy and a great benefit to the country if all habitual criminals were resolutely segregated under merciful surveillance and peremptorily denied opportunities for producing offspring. It would abolish a source of suffering and misery to a future generation, and would cause no unwarrantable hardship in this.

Diplomas.—It will be remembered that Mr. Booth's classification did not help us beyond classes higher than S in civic worth. If a strong and widely felt desire should arise, to discover young men whose position was of the V, W or X order, there would not be much difficulty in doing so. Let us imagine, for a moment, what might be done in any great University, where the students are in continual competition in studies, in athletics, or in public meetings, and where their characters are publicly known to associates and to tutors. Before attempting to make a selection, acceptable definitions of civic worth would have to be made in alternative terms, for there are many forms of civic worth. The number of men of the V, W or X classes whom the University was qualified to contribute annually must also be ascertained. As was said, the proportion in the general population of the V class to the remainder is as 1 to 300, and that of the W class as 1 in 3000. But students are a somewhat selected body because the cleverest youths, in a scholastic sense, usually find their way to Universities. A considerably high level, both intellectually and physically, would be required as a qualification for candidature.

The limited number who had not been automatically weeded away by this condition might be submitted in some appropriate way to the independent votes of fellow-students on the one hand, and of tutors on the other, whose ideals of character and merit necessarily differ. This ordeal would reduce the possible winners to a very small number, out of which an independent committee might be trusted to make the ultimate selection. They would be guided by personal interviews. They would take into consideration all favourable points in the family histories of the candidates, giving appropriate hereditary weight to each. Probably they would agree to pass over unfavourable points, unless they were notorious and flagrant, owing to the great difficulty of ascertaining the real truth about them. Ample experience in making selections has been acquired even by scientific societies, most of which work well, including perhaps the award of their medals, which the fortunate recipients at least are tempted to consider judicious. The opportunities for selecting women in this way are unfortunately fewer, owing to the smaller number of female students between whom comparisons might be made on equal terms. In the selection of women, when nothing is known of their athletic proficiency, it would be especially necessary to pass a high and careful medical examination; and as their personal qualities do not usually admit of being tested so thoroughly as those of men, it would be necessary to lay all the more stress on hereditary family qualities, including those of fertility and prepotency.

Correlation between Promise in Youth and subsequent Performance.—No serious difficulty seems to stand in the way of classifying and giving satisfactory diplomas to youths of either sex, supposing there were a strong demand for it. But some real difficulty does lie in the question—Would such a classification be a trustworthy forecast of qualities in later life? The scheme of descent of qualities may hold good between the parents and the offspring at similar ages, but that is not the information we really want. It is the descent of qualities from men to men, not from youths to youths. The accidents that make or mar a career do not enter into the scope of this difficulty. It resides entirely in the fact that the development does not cease at the time of youth, especially in the higher natures, but that faculties and capabilities which were then latent subsequently unfold and become prominent. Putting aside the effects of serious illness, I do not suppose there is any risk of retrogression in capacity before old age comes on. The mental powers that a youth possesses continue with him as a man; but other faculties and new dispositions may arise and alter the balance of his character. He may cease to be efficient in the way of which he gave promise, and he may perhaps become efficient in unexpected directions.

The correlation between youthful promise and performance in mature life has never been properly investigated. Its measurement presents no greater difficulty, so far as I can foresee, than in other problems which have been successfully attacked. It is one of those alluded to in the beginning of this lecture as bearing on race-improvement, and being on its own merits suitable for anthropological inquiry. Let me add that I think its neglect by the vast army of highly educated persons who are connected with the present huge system of competitive examinations to be gross and unpardonable. Neither schoolmasters, tutors, officials of the Universities, nor of the State department of education, have ever to my knowledge taken any serious step to solve this important problem, though the value of the present elaborate system of examinations cannot be rightly estimated until it is solved. When the value of the correlation between youthful promise and adult performance shall have been determined, the figures given in the table of descent will have to be reconsidered.

Augmentation of Favoured Stock.—The possibility of improving the race of a nation depends on the power of increasing the productivity of the best stock. This is far more important than that of repressing the productivity of the worst. They both raise the average, the latter by reducing the undesirables, the former by increasing those who will become the lights of the nation. It is therefore all important to prove that favour to selected individuals might so increase their productivity as to warrant the expenditure in money and care that would be necessitated. An enthusiasm to improve the race would probably express itself by granting diplomas to a select class of young men and women, by encouraging their intermarriages, by hastening the time of marriage of women of that high class, and by provision for rearing children healthily. The means that might

be employed to compass these ends are dowries, especially for those to whom moderate sums are important, assured help in emergencies during the early years of married life, healthy homes, the pressure of public opinion, honours, and above all the introduction of motives of religious or quasi-religious character. Indeed, an enthusiasm to improve the race is so noble in its aim that it might well give rise to the sense of a religious obligation. In other lands there are abundant instances in which religious motives make early marriages a matter of custom, and continued celibacy to be regarded as a disgrace, if not a crime. The customs of the Hindoos, also of the Jews, especially in ancient times, bear this out. In all costly civilisations there is a tendency to shrink from marriage on prudential grounds. It would, however, be possible so to alter the conditions of life that the most prudent course for an X class person should lie exactly opposite to its present direction, for he or she might find that there were advantages and not disadvantages in early marriage, and that the most prudent course was to follow their natural instincts.

We have now to consider the probable gain in the number and worth of adult offspring to these favoured couples. First as regards the effect of reducing the age at marriage. There is unquestionably a tendency among cultured women to delay or even to abstain from marriage; they dislike the sacrifice of freedom and leisure, of opportunities for study and of cultured companionship. This has to be reckoned with. I heard of the reply of a lady official of a College for Women to a visitor who inquired as to the after life of the students. She answered that one-third profited by it, another third gained little good, and a third were failures. "But what becomes of the failures?" "Oh, hey marry."

There appears to be a considerable difference between the earliest age at which it is physiologically desirable that a woman should marry and that at which the ablest, or at least the most cultured, women usually do. Acceleration in the time of marriage, often amounting to 7 years, as from 28 or 29 to 21 or 22, under influences such as those mentioned above, is by no means improbable. What would be its effect on productivity? It might be expected to act in two ways:—

(1) By shortening each generation by an amount roughly proportionate to the diminution in age at which marriage occurs. Suppose the span of each generation to be shortened by one-sixth, so that six take the place of five, and that the productivity of each marriage is unaltered, it follows that one-sixth more children will be brought into the world during the same time, which is, roughly, equivalent to increasing the productivity of an unshortened generation by that amount.

(2) By saving from certain barrenness the earlier part of the child-bearing period of the woman. Authorities differ so much as to the direct gain of fertility due to early marriage that it is dangerous to express an opinion. The large and thriving families that I have known were the offspring of mothers who married very young.

The next influence to be considered is that of healthy homes. These and a simple life certainly conduce to fertility. They also act indirectly by preserving lives that would otherwise fail to reach adult age. It is not necessarily the weakest who perish in this way, for instance, zymotic disease falls indiscriminately on the weak and the strong.

Again, the children would be healthier and therefore more likely in their turn to become parents of a healthy stock. The great danger to high civilisations, and remarkably so to our own, is the exhaustive drain upon the rural districts to supply large towns. Those who come up to the towns may produce large families, but there is much reason to believe that these dwindle away in subsequent generations. In short, the towns sterilise rural vigour.

As one of the reasons for choosing the selected class would be that of hereditary fertility, it follows that the selected class would respond more than other classes to the above influences.

I do not attempt to appraise the strength of the combined six influences just described. If each added one-sixth to the produce the number of offspring would be doubled. This does not seem impossible considering the large families of colonists, and of those in many rural districts; but it is a high estimate. Perhaps the fairest approximation may be that these influences would cause the X women to bring into the world an average of one adult son and one adult daughter *in addition* to what they would otherwise have produced. The table of descent applies to one son or to one daughter per couple; it may now be read as

specifying the net gain and showing its distribution. Should this estimate be thought too high, the results may be diminished accordingly.

It is no absurd idea that outside influences should hasten the age of marrying and make it customary for the best to marry the best. A superficial objection is sure to be urged that the fancies of young people are so incalculable and so irresistible that they cannot be guided. No doubt they are so in some exceptional cases. I lately heard from a lady who belonged to a county family of position that a great aunt of hers had scandalised her own domestic circle two generations ago by falling in love with the undertaker at her father's funeral and insisting on marrying him. Strange vagaries occur, but considerations of social position and of fortune, with frequent opportunities of intercourse, tell much more in the long run than sudden fancies that want roots. In a community deeply impressed with the desire of encouraging marriages between persons of equally high ability, the social pressure directed to produce the desired end would be so great as to ensure a notable amount of success.

Profit and Loss.—The problem to be solved now assumes a clear shape. A child of the X class (whatever X signifies) would have been worth so and so at its birth, and one of each of the other grades respectively would have been worth so and so; 100 X parentages can be made to produce a net gain of 100 adult sons and 100 adult daughters who will be distributed among the classes according to the standard table of descent. The total value of the prospective produce of the 100 parentages can then be estimated by an actuary, and consequently the sum that it is legitimate to spend in favouring an X parentage. The clear and distinct statement of a problem is often more than half way towards its solution. There seems no reason why this one should not be solved between limiting values that are not too wide apart to be useful.

Existing Activities.—Leaving aside profitable expenditure from a purely money point of view, the existence should be borne in mind of immense voluntary activities that have nobler aims. The annual voluntary contributions in the British Isles to public charities alone amount, on the lowest computation, to fourteen million pounds, a sum which Sir H. Burdett asserts on good grounds is by no means the maximum obtainable. ("Hospitals and Charities," 1898, p. 85.)

There are other activities long since existing which might well be extended. I will not dwell, as I am tempted to do, on the endowments of scholarships and the like, which aim at finding and educating the fittest youths for the work of the nation; but I will refer to that wholesome practice during all ages of wealthy persons interesting themselves in and befriending poor but promising lads. The number of men who have owed their start in a successful life to help of this kind must have struck every reader of biographies. This relationship of benefier and befriended is hardly to be expressed in English by a simple word that does not connote more than is intended. The word "patron" is odious. Recollecting Dr. Johnson's abhorrence of the patrons of his day, I turned to an early edition of his dictionary in hope of deriving some amusement as well as instruction from his definition of the word, and I was not disappointed. He defines "patron" as "a wretch who supports with insolence and is repaid with flattery." That is totally opposed to what I would advocate, namely a kindly and honourable relation between a wealthy man who has made his position in the world and a youth who is avowedly his equal in natural gifts, but who has yet to make it. It is one in which each party may well take pride, and I feel sure that if its value were more widely understood it would become commoner than it is.

Many degrees may be imagined that lie between mere befriending and actual adoption, and which would be more or less effective in freeing capable youths from the hindrances of narrow circumstances; in enabling girls to marry early and suitably, and in securing favour to their subsequent offspring. Something in this direction is commonly but half unconsciously done by many great landowners whose employments for man and wife, together with good cottages, are given to exceptionally deserving couples. The advantage of being connected with a great and liberally managed estate being widely appreciated, there are usually more applicants than vacancies, so selection can be exercised. The consequence is that the class of men found upon these properties is markedly superior to those in similar positions elsewhere. It might well become a point of honour, and as much an avowed object, for noble families to gather fine specimens of humanity around them, as it is to

procure and maintain fine breeds of cattle and so forth, which are costly, but repay in satisfaction.

There is yet another existing form of princely benevolence which might be so extended as to exercise a large effect on race improvement. I mean the provision to exceptionally promising young couples of healthy and convenient houses at low rentals. A continually renewed settlement of this kind can be easily imagined, free from the taint of patronage, and analogous to colleges with their self-elected fellowships and rooms for residence, that should become an exceedingly desirable residence for a specified time. It would be so in the same way that a good club by its own social advantages attracts desirable candidates. The tone of the place would be higher than elsewhere, on account of the high quality of the inmates, and it would be distinguished by an air of energy, intelligence, health and self-respect and by mutual helpfulness.

Prospects.—It is pleasant to contrive Utopias, and I have indulged in many, of which a great society is one, publishing intelligence and memoirs, holding yearly elections, administering large funds, establishing personal relations like a missionary society with its missionaries, keeping elaborate registers and discussing them statistically with honest precision. But the first and pressing point is to thoroughly justify any crusade at all in favour of race improvement. More is wanted in the way of unbiased scientific inquiry along the many roads I have hurried over, to make every stepping-stone safe and secure, and to make it certain that the game is really worth the candle. All I dare hope to effect by this lecture is to prove that in seeking for the improvement of the race we aim at what is apparently possible to accomplish, and that we are justified in following every path in a resolute and hopeful spirit that seems to lead towards that end. The magnitude of the inquiry is enormous, but its object is one of the highest man can accomplish. The faculties of future generations will necessarily be distributed according to laws of heredity, whose statistical effects are no longer vague, for they are measured and expressed in formulæ. We cannot doubt the existence of a great power ready to hand and capable of being directed with vast benefit as soon as we shall have learnt to understand and to apply it. To no nation is a high human breed more necessary than to our own, for we plant our stock all over the world and lay the foundation of the dispositions and capacities of future millions of the human race.

OCEAN CIRCULATION.¹

THE investigation carried on by Mr. H. N. Dickson into the distribution of temperature and salinity in the surface water of the North Atlantic is one of great importance. It promises, if continued, to be of considerable value, not only to those who are especially interested in studying the circulation of the surface water of the Ocean, but also to meteorologists generally and particularly to those who see, in a comparison of the varying yearly temperatures of the North Atlantic with that of a mean for the season, the key to a clearer knowledge of the causes which combine to influence the climate of western Europe, and especially of our Islands, and who look hopefully in that direction for information whereby future modifications in the conditions of climate may be foretold for periods some time in advance.

The treatise before us, setting forth the author's method of conducting the research and the results at which he arrived, was contributed to the Royal Society in March, 1900.

In introducing his subject the author says: "The history of our knowledge of the currents of the North Atlantic Ocean up to the year 1870 has been written once for all by Petermann," whom he quotes at some length, remarking "that the conclusions, then arrived at, were not modified by the observations of the next twenty years."

During the years 1896 and 1897 materials were collected for preparing the charts of temperature and salinity, the parallel of 40° N. being selected as the southern boundary of the area for investigation. The observations of temperature were furnished by the Meteorological Office, the Danish Meteorological Department, the United States Hydrographical Department, and the Bureau Central Météorologique de France, and by Prof. Pettersson. The samples of water for the determination of salinity were obtained from the captains of vessels keeping logs

¹ *Phil. Trans.* of the Royal Society:—"The Circulation of the Surface Waters of the North Atlantic Ocean." By H. N. Dickson.

for the Meteorological Office and for the Danish Hydrographical Department, specially made bottles being supplied to them for the purpose, and no care being spared in guarding against impurity or the introduction of any matter that could give rise to error in the analytical determinations.

The accuracy of the method adopted in estimating the salinity of the samples was subjected to severe scrutiny. The author states the results of his observations, demonstrating the distribution of temperature and salinity for each month during the year 1896 as shown in the charts prepared by him, in which the isotherms and isohalines are supplemented by a scale of colouring denoting areas having the same range of temperature and the same range of salinity. He calls attention to the general agreement between the distribution of salinity as shown on the one set of charts and that of temperature as shown on the other set when apparent, and notes departures and irregularities when they occur. He then deals in the same manner with the observations of 1897 and compares results.

Taking the means of each month respectively for the two years, the distribution of temperature, as shown on these charts, corresponds fairly well with the distribution of sea-surface temperature given on the quarterly sea-temperature charts on the North Atlantic, issued by the Meteorological Office in 1884.

For the purpose of defining the limits of ocean currents and of arriving at some estimate as to its relative velocity in different localities, the information to be gained by the thermometer is invaluable, for over areas little frequented by shipping where current observations are necessarily sparse, a comparatively insignificant number of sea-surface observations will suffice to indicate the existence or failure of an ocean stream; and if to these detective signs be added observations of salinity, the evidence acquired becomes still more complete.

The effects of the cold water from the north in deflecting the warm stream from the westward are clearly shown on these charts, which, when seasonal variation in temperature has been made allowance for, appear in good agreement (speaking generally) with the monthly current charts of the North Atlantic, published by the Admiralty, as regards the area over which the warm water of the Gulf Stream is distributed, each month, and the northern and western limits to which it reaches. The indications of the existence of Gulf Stream water, stated roughly, may be traced on the Admiralty Chart to the following limits in the given months:—

January.—The stream does not reach to the eastward of 20° W., and a south-easterly set is apparent off Ireland.

February.—In 55° N. it reaches 15° W.; a south-easterly set is found to the westward of Ireland, and a south-westerly to the south-westward of the Fastnet Rock.

March.—It has advanced to the coast of Ireland.

April.—In 55° N. its limit has receded to 20° W., and the Iceland south-going current begins to show itself north of 55° N.

May.—The Gulf Stream and Davies Strait cold current combine in 47° N. 27° W., the Iceland current sets S. and S.W. to 48° N. 30° W.

June.—Gulf Stream to 15° W. in 52° N. Iceland and Denmark Strait cold currents to Irish coast.

July.—To the S. of 50° N. it joins the Iceland and Denmark Strait current in about 48° N. off the Bay of Biscay.

August.—It extends to the north of Ireland but is modified in about 20° W. by a south-going set.

September.—It extends to the north of Scotland.

October.—It is found in 10° W. in 59° N.

November.—The data are insufficient, but the Stream is traceable to 19° W. in 59° N.

December.—It is difficult to trace the Stream eastward of 40° N. in 45° W. A south-going cold current is shown to the north-westward and westward of Ireland; there is a persistent southerly (S. E. to S. W.) movement of water in the eastern half of the Atlantic.

Mr. Dickson's charts show the existence of Gulf Stream water to the northward and westward of the limits given above for several months, notably on the January chart, and the explanation doubtless is that the value of the current being small, it has been inappreciable in navigation.

There exists, during the greater part of the year, a movement of water eastward, which divides, at a varying distance to the westward of the English Channel. One arm branches towards the Bay of Biscay, the other northward (Rennell's Current). The latter is well known to the captains of the large