ON SECONDARY BIAS IN OBJECTIVE JUDGMENTS.

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I.

The scientist sets before himself the ideal of a perfectly impartial account of the external world. In proportion as he frees his work from personal prejudice is its outcome successful. The facts may be unwelcome, they may run counter to his desires and mean the overthrow of long-cherished ideals; but these elements of sentimental valuation have no place in the world of scientific truth; except, indeed, as themselves matters for investigation and record like all other phenomena. To suppress facts because they are at variance with an already accepted theory, or to warp them in the direction of a desired interpretation, means the destruction of science; it is a denial of the possibility of a system of objective knowledge. For it is the effort of science to transcend the limitations of the individual and to establish those principles which are independent of subjective bias and form the body of truth common to all observers.

Deliberate distortion or suppression of facts the scientist does not discuss. One guilty of such acts manifests a purpose which is radically distinct from that of the investigator. The scientist presupposes sincerity of purpose in the observer together with honesty and reliability in the record, in so far as these results are dependent upon the intention of the investigator. Honesty of purpose, however, is but the starting-point of accuracy in the record; and the advance of science has involved at every stage of its progress a renewed criticism of the conditions of observation, and an investigation of the possible sources of error to which its methods are liable.

The personal or psychological factors of distortion which thus appear in the report of an external event by any observer

may be grouped in two classes, physical and mental. The first of these embraces all the external conditions of observation, including the mechanisms of perception; the second consists of the various sources of unconscious bias which inhere in the intellectual processes of the observer. The former are relatively stable and of comparatively easy correction. The computation of their values is always incidental to the presentation of results. Such are the correction for time and space differences, the calculation of probable errors, the establishment of the observer's personal equation, and the like.

Errors of the second class are of a different nature. Their character is peculiarly personal and unpredictable, their range undeterminable and their value largely unquantifiable. The existence of such subjective bias in any given case may be assumed, but its direction and amount can only be estimated in the roughest and most general way from an acquaintance with the mental habits of the observer. And even this correction can be applied only to certain large features of a man's work, such as his philosophical interpretation of scientific data. In a multitude of cases it is wholly impossible to estimate the correction which should be made in an individual report, or even to guess at the nature of the factors which are operative in the process of subjective distortion; and though the error thus introduced is commonly trivial it may rise on occasion to great and tragic importance.

To give an unprejudiced account of any event is a practical impossibility. It takes shape within each individual consciousness in dependence upon the dominant system of values and modes of organization which that mind possesses; and the variations in the reports given by any person and his fellows will be proportional to the differences in interests and habits which exist between them. These variations need not present discrepancies,—though they commonly extend even to contradictions—but may involve only changes in proportion and emphasis. It is notorious that the violence of the external stimulus alone does not determine the intensity or permanence of the impression which is made upon consciousness in any given case. The general habit of attending to such stimuli and the

openness of the mind at the moment are more important factors than the absolute magnitude of the stimulus. In other words, selective attention working under the guidance of our organic interests operates upon the materials and processes of the external world, adding accentuation and emphasis, seizing upon and preserving certain elements which we call pleasing or important, and relegating the rest to obscurity or oblivion. Often the account in which this recasting results is unrecognizable by a fellow-observer of the event. The existence of subjective bias is thus not an incidental error in our observations but is fundamental to the very character of the human mind. We can conceive its elimination only in an absolutely dispassionate consciousness devoid of feeling and purpose.

This universal bias roots in the fact that at each moment of our experience some one interest is for the time being paramount, and determines both the objects which shall be attended to and the interpretation which they shall receive. The nature of any reality with which the mind concerns itself, whether objective or subjective, is as much affected by every change in this system of inner relations into which it is woven as is the appearance of a physical object by being overturned and regarded from a new point of view. One may identify the object with that of the moment preceding, but at best it is the same with a difference. A new set of angles appears and its relations with other things have changed. The type of new crystallization within the mind has given the object a fresh meaning through the introduction of a novel system of emphases, and its character as a mental object has thereby been transformed. The very hold which an impression or idea has on the mind depends upon the existing system of relations in which it is caught up, and which is expressed in the temporary or permanent disposition of the mind. It must in some way fit the purpose of the moment or appeal to an organic habit if it is to take intelligible shape before consciousness. While reading a book, for instance, one disregards wholly the width of the margins, the smoothness, rigidity and rectangularity of the covers, and the weight of the volume, any one of which might, on another occasion, be the important aspect to take into account in considering the object,

if one were in search, say, of a paper-weight, a straight edge, a writing-pad, or wished to make marginal comments upon the contents. The perception of symmetry in visual forms, again, expresses the fact that the mind wills to attend only to those lines and masses which present geometrical balance; for in every such design the possibilities of unsymmetrical construction are incomparably more manifold than those of the regular systems upon which the eye dwells, and the apprehension of the latter depends upon an ignoring of all that is formless or disproportionate, which can be referred only to the organic disposition of the perceiving mind itself.

This subjective selection and emphasis pervades all mental activities, perceptive, imaginative and rationalizing. It is expressed alike in the construction of an orderly world of objects and space relations to which our senses give rise, and in the determination of the course of ideal association in our purposeful thinking. But this universal aspect of human consciousness once acknowledged, we are no longer concerned with its existence. It is as proper to point out that it is the basis of intelligibility in the world and of a rational adjustment to its changes, as to recognize that the apprehension of that world varies from moment to moment in dependence upon transitions in the point of view and present purpose of the beholder.

It is only when a bias of the second order appears that the detection of the presence and magnitude of the errors involved assumes practical importance, when our types of confessedly selective perception and representative thought are distorted by factors of evaluation of whose presence we are unaware at the moment of judgment. Such are the familiar space and time errors of which account must be taken in reducing observations involving position and movement, or comparisons of events in serial order. Such are also the sources of unconscious prejudice which influence personal opinion of men and events.

The interest of the psychological student in these phenomena does not concern the mere fact of their existence. The presence of such modifying influences may be presupposed in all cases; they are pervasive as gravitation. The judgment made at any given moment reflects, in a way, the whole system of

stimulations, inner as well as outer — which is operative in determining the cast of the mind at the moment. One's judgment of the comparative intensity of a sound, for instance, depends upon both the character of the auditory impressions which have just preceded it, and the whole system of stimuli acting upon the senses at the moment time ; as well as upon the physiological activity of the body and conditions of attention and alertness on the part of the subject.

The same holds true of all judgments concerning the qualities and the relations of objects in the world about us ; and part of the work of the psychological observer is of course to determine for all important modifying influences of this kind the typical curves of value which they manifest in connection with a series of systematic variations in their concomitants. The investigations of color-contrast, of hetero-sensorial reinforcement, of the influence of distraction upon judgment, are cases in point.

One approaches a more obscure and difficult problem in passing from investigations of sense perception and memory to judgments based upon conceptual processes, or comparisons of objects so complex that many significant relations exist between them and the mind which judges. Especially is this the case with all humanly real objects, those, namely, which do not simply receive a fictitious existence in the laboratory, conferred for the direct purpose of affording material for the judgment in question, but which are reacted upon naturally and seriously because they enter into real relations with the practical business of life. In the latter case every significant point of view from which the object has ever been regarded becomes a possible source of secondary bias ; its practical, its political, its æsthetic, its historical, its religious value — each and all may affect one's judgment of even its immediate physical characters.

We exaggerate the size of our gods and heroes, making them "larger than human" not only because the conception of bodily prowess so frequently lies back of the thought, but also because the estimation in which we hold their political or moral significance tends to be reflected in our representation of their bodily appearance. The example is but an illustration of a class of effects which, as in the former case, we may presume

to be present, in some form or other and to some given extent, in all such judgments. The important and familiar places of the world, for instance, we should probably find to be located by each person at points on the average nearer to himself, and places historically or politically obscure at points more distant than their actual geographical positions. In exemplification of this general class of effects I have been at pains to determine the existence and influence of certain forms of such secondary bias in a single selected series of cases, the results of which are presented in the remainder of this paper.

The inquiry arose from a discussion of the variability of individual judgment with regard to the comparative weight of bank-notes and coin, and the sources of constant error which affected such estimation. The raising of this question led Dr. J. F. Messenger to institute an inquiry the results of which were published in the form of a note in *Science*, April 25, 1902. In his report the writer commented upon three things, the comparative accuracy of judgment in the two sexes, the amount of the constant error involved, and the influence upon such judgments of the symbolic value of the bills in question. With the last of these points the present inquiry began, as preliminary to the larger series of comparisons to be reported later in the paper. The question to be answered was of the simplest character: How many bills together equal the weight of a silver dollar? This question was asked concerning two denominations, one-dollar and ten-dollar notes.

It was impossible to ask for judgment on these two points consecutively of the same person, consistently with the object in view; since the naïveté of the subject's attitude which is essential to the success of the inquiry would thereby have been destroyed, and the calling of attention to the point in question would certainly result, though in an unpredictable proportion of cases, in a rectification of judgment, and the elimination of that very error the presence of which in uncritical judgments was the matter under determination. In order to approach the question it was therefore necessary to obtain reports from two groups of observers, taken as nearly as possible from the same class of subjects, and in sufficient numbers to offset the disad-

vantage occasioned by the lack of direct comparison between judgments made by the same individual. Those to whom the question was put were all public school children of the five upper grades. The selection of this class of subjects arose partly from its accessibility, partly from the desire to note any changes in the character of the judgments which appeared in connection with advance in age. Comparison of the judgments made by the two sexes will have to be reserved, as answers have hitherto been received from classes of girls only. The observers were all pupils of a single school, of such a size that each of the grades in question was subdivided into sections, and the two inquiries were made alternately of these groups. The total number of answers received, — exclusive of those cast out on account of defect — was 646, distributed as follows:

TABLE I.

Grade	One Dollar	Ten Dollar.	Total.
IV.	67	56	123
V.	155	116	271
VI.	78	66	144
VII.	40	42	82
VIII.	15	11	26
Totals	355	291	646

Of this total the last group of 26 should probably be put aside in considering the results, as the number is too small to form the basis of any reliable conclusion in regard to a question in which the index of variability is so high as it is here.

The average numbers of bills of each denomination judged to equal the weight of a silver dollar by pupils of the various grades are as follows:

TABLE II.

Grade	One Dollar	Ten Dollar	Average.
IV.	215	125	170
V.	98	97	97
VI.	99	44	71
VII.	84	52	68
Average.	124	79.5	101.5
VIII.	112	122	117

The returns from the small group of eighth grade pupils which appear at the bottom of the table, have not been included in making up the averages. The remaining figures show a considerable preponderance, for the whole series, and in each grade at least an excess, in the number of bills of the lower denomination over that of the higher which is judged to make a weight equal to that of a silver dollar.

When the individual variability is so high as to include extremes of five, and twice as many thousands which appear in these guesses at the weight of a banknote, it is only when a decidedly large group of answers is taken into account that the average possesses any real significance. The ratio presented by any single grade may therefore be held undecisive; but the fact that the average number of one dollar bills is greater than that of the tens in the ratio of 24 : 79.5 when the whole series of 600 comparisons is considered, may be taken as settling at least the question of the presence of this factor of secondary bias in judgments of this nature.

Whether the prevalence of this type of confusion tends to increase with age the present figures can hardly be said to show, though the evidence which they afford is favorable to such a conclusion. The intimacy of the association between the perception of a bill of any denomination and its representative value undoubtedly increases as one's familiarity with the use and exchange of money grows. Without this experience the source of error which appears in these judgments would of course not exist, and it is during the years comprised within the present series that the child acquires this knowledge. It may be said, therefore, that the factor upon which the distortion of judgments depends is taking on greater reality and importance during this period, and that a progressive increase in the error might be looked for. It is also true that if the series of four grades be divided into junior and senior groups, the error in the latter will be found nearly half as great again as in the former. Nevertheless the construction of such a curve demands both the determination of a large number of points and a more consistent sequence among them than is here presented.

Another developmental feature, it may be noted in passing, is

fairly well-marked in these papers. The number of bills which equals the weight of a silver dollar, if we regard the quantitative average solely, is consistently exaggerated, since its actual value is about twenty; but the amount of overestimation is successively reduced from grade to grade, as appears from the series of averages which is attached to Table II. in the last vertical column. The judgment of the child concerning the weight of bills in general is undergoing the progressive rectification, at the same time that the element of secondary bias is, or may be, increasing.

In any such case as the present, however, the figures already given leave one largely in the dark as to the real distribution of the guesses. We need to know the constellation of the judgments as well as their quantitative averages. The mean of the series, which is the index of this distribution, is given in the following table for each grade and denomination separately:

TABLE III.

Grade.	One Dollar.	Ten Dollar.
IV.	20	20
V.	25	25
VI.	25	20
VII.	50	25
VIII.	100	120

These figures suggest comparison with the results obtained by Messenger, and by Pierce (*Science*, Nov. 7, 1902, p. 745) from college students and other grown persons. In the first of these reports the average (of all judgments) was 201 times and the mean 8 times the actual number involved. In the second (Dr. Pierce's group) the average was 15.8 times and the mean 4.3 times too great. In the present series the average for the four grades considered is 10.2 times and the mean 1.3 times the actual number. The data are perhaps not sufficient as regards numbers for a valid comparison of the two series of judgments and lack continuity through the intervening ages; but the results of the observations so far accessible (based roughly upon 600 reports in each case) do at least show a striking difference in the correctness of the estimates made by school children from

nine to fifteen years of age, in the present series, and by college students or more mature persons, as reported by the two investigators already quoted.

If the two sets of figures representing the quantitative average of the mean value of the median estimate for successive years be compared they will be found to present inverse relations. The average is steadily reduced with age, the mean is progressively increased. Of these two series the change in the first indicates only the elimination of scattering judgments which show an uncritical and excessive estimate. A larger and larger number of the children, as they grow older, are coming to have a more or less intelligent idea of the relations of weight between the two objects. But these averages do not necessarily mean that a more accurate apprehension of their comparative weights is being developed among the members of this group themselves. It does not even show the character and changes of the constant error, if such exist. The index of the latter is found in the series of median values; and these show that while the correction of extravagant misjudgments is steadily lowering the quantitative average of the series, the tendency of the majority of observers to underestimate the weight of the bill is progressively mounting. If we may take the present results and those with which they are here compared as typical—and the averages in each of the two cases are based roughly upon 300 individual judgments—the perception of the child—in these matters is much more accurate and free from prejudice than that of the grown person; and there is reason to suppose from that part of the curve which the present investigation affords, that the carrying up of the reports through the intervening years would show a fairly continuous series connecting these extremes of judgment.

It may be worth while to call attention to another form of secondary bias which these estimates of weight present. It appears in the distribution of individual judgments in relation to odd and even numbers, and to decimal nodes, or 'round numbers.' Out of the total series of judgments even numbers were given in 517 cases, odd numbers—exclusive of unity and multiples of five—in 16 cases only. This preponderance arises

from the frequency of even tens, hundreds, etc.; the occurrences of unity and odd multiples of five amount to 166, while the total number of five-multiples is 590.¹ This clustering of the judgments about decimal nodes and semi-nodes is shown graphically in the diagram (Chart I.), in which the height above zero of the vertical lines indicates the frequency with which the

Chart I.

numbers at their bases occur in the returns, while that of the horizontals between them represents the average for all the intervening numbers. For further elucidation the numerical values are put above their respective graphical indices.

The guesses may practically be said to consist of ones, fives, tens, etc. The whole series of intervening numbers is represented by only one judgment in seven. Of these maxima, '10' and '100' occur with more than twice the average frequency of the rest. The falling off in the '1,000' judgment is due to the

¹ In this later reduction only unintelligible papers were cast out, whereas in the former case all but those which were wholly unambiguous were rejected. For instance the answer '20 or 30' was now retained though previously eliminated. The total number of observations, therefore, appears greater than before.

small total number of guesses which reached this magnitude, but the attraction which 'round numbers' possess is shown by the fact that though this point lies near the upper limit of distribution, the number of cases in which '1,000' was given as the estimate is three times that in which '500' occurred.

For comparison a second diagram (Chart II.) is appended in which I have represented a set of figures given in a paper by A. Williams in the *Scientific American Supplement* for March 16, 1889, entitled 'Favorite Numbers.' These figures were taken from the preceding United States census, and indicate in terms of thousands the number of persons in Alabama who reported themselves to be one of the ages named at the bottom of the chart.

The strongly marked maxima at 30, 35 and 40 years need not be pointed out, but it should be noted also that, as in the

Chart II.

present series of judgments, the maxima at the even tens are higher than at the intervening fives. The peculiar form of this curve must of course be wholly due to subjective distortion, and the more abrupt contrast between the maxima and intervening low plateaus in the preceding diagram is due to the greater freedom of choice in estimating the weights than in reporting ages. It is to be expected that in the upper tens, for example, one should put the number at 70 rather than 69 or 71; but the

fact that a similar constellation appears among the series of estimations running from unity to ten shows clearly the existence of this preference for particular numbers. The sum of the judgments distributed among the numbers one, five, and ten is 207, while the aggregate for the other eight is but 44, or one twelfth as many to each number.

III.

The purpose of the main investigation, like that already described, was to determine the influence exerted by secondary associations upon one's representation of the physical qualities and relations of objects. The special associations which guided the selection of individuals were those of political and historical importance. An exact order of precedence in such a case cannot of course be established, since the valuation is subject to fluctuations dependent upon the individual who passes judgment upon the returns, but at least the whole series may be divided into two groups according as the objects contained in them have more or less importance of the kind in question, and comparison may roughly be made between the upper and lower regions of this scale.

Four series were prepared, each consisting of ten objects concerning which judgment was to be made, and the members of these series were to be arranged according to what the observer conceived to be their real order. In cases of doubt bracketing was to be avoided and the two or more objects put in serial order, even if recourse to guessing was necessary. The adoption of this method in such exceptional cases was based upon the presumed existence of preference even in an allotment of this kind; but when the uncertainty extended to many of the series this recourse would serve no good purpose, and the observer left the returns uncompleted or untouched. As the differences among the objects were fairly large and the order merely relative the occurrence of imperfect lists was rare, and all these were cast out in making up the returns.

The papers were first submitted to two university classes, consisting of 55 women and 19 men of mature age; they were then sent to the Principals of five New York public schools and

were marked under their supervision by 204 pupils distributed as follows :

TABLE IV.

Age.	11	12	13	14	15	16	Total
Boys.	8	16	28	13	2	—	67
Girls.	—	11	40	43	25	18	137
Total.	8	27	68	56	27	18	204

In the first list ten of the countries of the world were arranged in alphabetical order and the observer was asked to give judgment of their territorial extent, putting the figure (1) before the largest, (2) before the next, and so on in order of size. In computing results the returns were entered one beneath another on a sheet of paper, the series in each individual return running horizontally from one to ten. The average position assigned to each country was then determined by dividing the sums of the several columns by the number of reports received, and the direction and amount of error was recorded in terms of plus and minus deviation from the true position of each in the series. Countries were marked plus (+) when the position assigned was too high in the scale, minus (—) when it was too low. The following illustration will obviate the necessity of referring again to the method, which was followed in reducing all the returns :

TABLE V.

SCHOOL C; GRADE 7 B, GIRLS; AGE 13 YEARS. LANDS.

A, Actual Order, B, Average Order Assigned; C, Error of Displacement.										
A.	4.00	8.00	5.00	7.00	6.00	10.00	3.00	1.00	9.00	2.00
B.	8.14	8.58	2.92	7.00	5.33	6.42	5.92	2.00	7.50	1.25
C.	-4.14	-0.58	+2.08	±0.00	+0.67	+3.58	-2.92	-1.00	+1.50	+0.75

The returns from university students are classified below, the alphabetical order in which the names were arranged in the original list being replaced by that of deviation, the series beginning with the highest overestimation and ending with the greatest underestimation which occurs :

TABLE VI.

Countries.	Men.	Women	Average
Palestine,	+ 2.3	+ 2.3	+ 2.3
German Empire,	+ 1.9	+ 2.0	+ 1.9
Switzerland,	+ 0.2	+ 1.2	+ 0.7
Italy,	+ 0.5	+ 0.6	+ 0.5
United States,	+ 0.6	+ 0.2	+ 0.4
Ceylon,	+ 0.4	± 0.0	+ 0.2
Siberia,	- 0.7	- 0.7	- 0.7
Iceland,	- 1.3	- 1.1	- 1.2
Afghanistan,	- 1.1	- 1.9	- 1.5
Peru,	- 2.4	- 2.5	- 2.4

In the returns from public school children which follow, the results from the five schools are given separately from their average under the headings A, B, C, D, E, for comparison as to uniformity of arrangement :

TABLE VII.

Countries.	A.	B	C.	D	E	Av.
Palestine,	+ 2.4	+ 3.3	+ 2.5	+ 2.2	+ 2.5	+ 2.6
German Empire,	+ 1.8	+ 2.1	+ 2.1	+ 2.8	+ 2.5	+ 2.3
Switzerland,	+ 0.9	+ 1.5	+ 1.9	+ 2.7	+ 2.0	+ 1.8
United States,	+ 0.7	+ 0.7	+ 0.7	+ 0.6	+ 0.7	+ 0.7
Italy,	+ 0.4	+ 0.7	+ 0.5	+ 0.8	+ 0.6	+ 0.6
Ceylon,	+ 1.1	- 0.7	+ 0.1	+ 0.6	- 0.4	+ 0.1
Iceland,	+ 0.1	- 0.1	- 0.6	- 0.9	+ 0.1	- 0.3
Siberia,	- 1.2	- 1.5	- 1.8	- 2.6	- 2.4	- 1.9
Afghanistan,	- 1.6	- 3.3	- 2.7	- 2.6	- 2.9	- 2.6
Peru,	- 4.2	- 2.8	- 2.6	- 3.6	- 3.1	- 3.3

Both of these tables present a systematic displacement which differs fundamentally in its curve from that to which the presence of scattering errors would give rise. From the middle of the group it rises by progressive increments of opposite signs to extremes which are separated by five places, or half the value of the series. Setting aside the question of detail, it is evident from this distribution that the separation of the system into upper and lower regions reflects the political and historical estimation in which the constituent lands are held. The important countries are overestimated, the obscure underestimated, and if the whole series should be divided into two groups on this principle, all those called important will be found in the upper half of the scale, all the obscure in the lower half.

The comparison can be carried farther; for the amount of displacement of a country roughly parallels its degree of nearness or remoteness in our interest. The strongest evidence of this is the resemblance which exist between the university and school tables, which are identical except for two exchanges in adjacent names, which in one case are separated by one half, in the other by one tenth of a place only. It should be remembered that when a limited series is taken the actual size of the country may modify the predicted curve of displacement; since as the upper limit is neared the number of minus errors will necessarily predominate, and the plus errors as one approaches the lower extreme. This is shown in the case of the United States, in which all the factors of secondary association which predispose to exaggeration are at their highest, while yet the country is overestimated by only half a point. The United States is however second largest in the series, and the error at its maximum could therefore be only unity.

There is another source of secondary bias which might be expected to show in these tables. Geographical distance is commonly associated with remoteness of interest; and where not submerged by other and dominant factors of error, as in a series of cities of the same class, or minor physical features such as rivers, its influence would doubtlessly be discernible. But in the present case the actual distance becomes an insignificant element in view of the facility of information and intimacy of relation which may exist between places far apart. Peru is nearer than Palestine, but is incomparably more remote in every significant application of the term, and a series of ten countries is quite too short to permit the demonstration of any such minor factors of bias.

The second list comprised a series of ten rivers selected from the four continents according to the same principle as in the case of lands. The two sets of results are given in the tables on page 113, university students in the first and school children in the second:

The same general comments are to be made on these tables as on those which preceded. The first six names are the same in the two tables, though not in identical order, and the division

TABLE VIII.

Rivers.	Men	Women	Average
Hudson,	+ 3.1	+ 3.6	+ 3.3
Thames,	+ 0.8	+ 3.9	+ 2.3
Danube,	+ 1.2	+ 1.4	+ 1.3
Rhine,	+ 0.1	+ 1.4	+ 0.75
Douro,	+ 1.3	+ 0.1	+ 0.7
Mississippi,	+ 0.9	+ 0.5	+ 0.7
Mackenzie,	- 0.7	- 1.5	- 1.1
Petchora,	- 1.5	- 1.2	- 1.3
Orange,	- 2.2	- 2.2	- 2.2
Lena,	- 2.7	- 4.7	- 3.7

TABLE IX.

Rivers	A	B	C	D.	E.	Av
Thames,	+ 4.6	+ 4.0	+ 4.6	+ 5.4	+ 4.5	+ 4.6
Hudson,	+ 3.5	+ 3.7	+ 4.2	+ 5.3	+ 5.5	+ 4.4
Rhine,	+ 1.9	+ 1.9	+ 1.3	+ 2.5	+ 2.0	+ 1.9
Mississippi,	+ 0.9	+ 0.9	+ 0.9	+ 0.9	+ 1.0	+ 0.9
Danube,	+ 1.8	- 1.0	+ 0.9	- 0.3	+ 1.1	+ 0.5
Douro,	- 0.1	- 1.0	- 0.2	- 1.1	- 0.9	- 0.7
Mackenzie,	- 2.7	- 1.0	- 2.0	- 2.4	- 2.6	- 2.1
Orange,	- 2.3	- 2.5	- 2.2	- 2.3	- 1.8	- 2.2
Petchora,	- 5.0	- 2.1	- 1.6	- 1.6	- 2.2	- 2.5
Lena,	- 6.4	- 4.7	- 6.2	- 6.4	- 6.1	- 6.0

into plus and minus groups is just such as would be made on the basis of historical importance. The Mississippi River, like the United States in the previous list, falls low in the group because it lies near the upper limit of the series, the greatest possible error of overestimation being unity. The greater influence of association upon judgment in the present case, as compared with that of countries, is shown in the range of variation, which here reaches a sum of seven places in one set of figures and ten in the other.

The factor of nearness or remoteness is also perceptible in the estimate of rivers, as appears from table X, in which the series has been rearranged in order of distance from the city of New York where the returns were made out :

In the judgments of both university students and school pupils the members of the nearer group are overestimated on the average 1.3 places, and those of the more distant group underestimated to the same degree. The strong influence of this factor of bias is shown in the fact that it is not only dis-

cernible but pronounced in a series both so short as the present and marked by such a major disguising feature as that which guided the selection.

TABLE X.

Rivers.	University.	School	Rivers	University	School.
Hudson,	+ 3.3	+ 4.4	Rhine,	+ 1.3	+ 1.9
Mississippi,	+ 0.7	+ 0.9	Danube,	- 1.3	+ 0.5
Mackenzie,	- 1.1	- 2.1	Petchora,	- 2.2	- 2.5
Douro,	+ 0.7	- 0.7	Orange,	- 3.7	- 2.2
Thames,	+ 2.3	+ 4.6	Lena,	+ 0.7	- 6.0
Average,	+ 1.18	+ 1.42	Average,	- 1.04	- 1.66

The third set of returns related to a group of American cities, which consisted of the capitals, together with one other place of importance, of five states of the Union. The names, as usual, were arranged in alphabetical order; and so far as came to the notice of the writer no one remarked the peculiar distribution of the cities in question. In the tabulations which follow, first of university students and second of school children, the names are arranged in pairs from each state in order to bring the errors of displacement into a clearer view :

TABLE XI.

Cities	Men	Women	Average.
Albany, N. Y.,	+ 0.3	+ 0.5	+ 0.4
Rochester, N. Y.,	- 1.8	- 1.7	- 1.7
Trenton, N. J.,	- 0.3	+ 0.3	$\pm$ 0.0
Camden, N. J.,	- 3.2	- 3.6	- 3.4
Harrisburg, Pa.,	+ 1.7	+ 1.8	+ 1.7
Allegheny, Pa.,	- 3.6	- 3.4	- 3.5
Springfield, Ill.,	+ 5.0	+ 3.5	+ 4.2
Quincy, Ill.,	- 0.8	- 0.5	- 0.6
Frankfort, Ky.,	+ 4.1	+ 3.0	+ 3.5
Newport, Ky.,	- 1.1	- 1.1	- 1.1

In both these sets of figures the influence of secondary bias is strongly marked. The size of the capital is almost uniformly exaggerated, while that of the other cities is underestimated. The error of displacement, whose extremes are separated by

almost nine places, is greater in regard to the distant cities, smaller in those which are near, with the exception of Newport, Ky. I can conceive no reason for this wholly anomalous case unless it has been confused with Newport, R. I., the social prominence of which might raise it to a position among the places overestimated. With this exception the second table, like the first, is consistent throughout.

TABLE XII.

Cities	A.	B.	C.	D.	E.	Average.
Albany, N. Y.,	+ 1.3	+ 1.4	+ 1.0	+ 0.8	+ 1.1	+ 1.1
Rochester, N. Y.,	- 3.4	- 2.5	- 3.3	- 2.0	- 2.9	- 2.8
Trenton, N. J.,	- 0.3	- 0.1	+ 0.3	- 0.2	- 1.5	- 0.2
Camden, N. J.,	- 3.3	- 2.9	- 3.4	- 3.1	- 3.4	- 3.2
Harrisburg, Pa.,	+ 3.4	+ 2.3	+ 1.5	+ 2.5	+ 1.1	+ 2.2
Allegheny, Pa.,	- 5.3	- 5.7	- 3.8	- 4.1	- 4.1	- 4.6
Springfield, Ill.,	+ 3.8	+ 4.8	+ 4.4	+ 3.7	+ 3.7	+ 4.1
Quincy, Ill.,	+ 0.4	- 1.3	- 0.7	- 1.7	- 1.3	- 0.9
Frankfort, Ky.,	+ 3.1	+ 3.5	+ 2.9	+ 3.9	+ 2.9	+ 3.3
Newport, Ky.,	+ 1.5	+ 0.9	+ 1.5	+ 1.1	+ 1.4	+ 1.3

In this series it is useless to look for a demonstrable error of displacement due to distance. The number of cities is altogether too small for such a curve to be seen across the dominant bias of political significance. Were the group enlarged, or taken from cities of the same class, it would undoubtedly appear.

The fourth and final list consists of a series of historical characters, monarchs, statesmen, explorers—belonging to various nations, and covering in their range a fairly extensive period. The observer was asked to arrange these in order of time, with a view to ascertaining whether the important and familiar personages were conceived to have lived in more recent, the obscure and unfamiliar in more remote times than those in which their lives actually fell. The results are given as before in order of error quantitatively from plus to minus, the former indicating in the present case an underestimation, and the latter an overestimation, of the intervening period. The first table gives the rating by university students:

The making up of such a list of men presents more difficulties

than any of the preceding series, on account of the variability of their associations not only among individuals but also among groups, in consequence of which the form of the curve is subject to modification by other important forms of secondary bias than that considered in the selection. For instance, it is to be expected that the lines of national relationship should be accentuated wherever the parentage of the observers is relatively homogeneous, or that characters treated in pure literature should present increased bias in the reports of educated and reading subjects. It is probable, in this connection, that the fascination which personages of romance and glory possess for children has raised Harun al Raschid and Charlemagne to the level which they hold in the returns from the public schools.

TABLE XIII.

Names.	Men.	Women.	Average
Drake,	+ 3.3	+ 2.3	+ 2.8
Champlain,	+ 2.5	+ 1.5	+ 2.0
Joan of Arc,	+ 1.3	+ 2.0	+ 1.6
Charlemagne,	+ 1.0	+ 1.8	+ 1.4
Harun al Raschid,	+ 0.1	+ 1.1	+ 0.6
Richelieu,	- 0.5	± 0.0	- 0.2
Franklin,	- 0.3	- 0.5	- 0.4
LaSalle,	- 0.6	- 1.6	- 1.1
Gustavus Adolphus,	- 3.0	- 2.9	- 2.9
Mazeppa,	- 3.9	- 3.7	- 3.8

TABLE XIV.

Names.	A	B	C	D.	E	Av.
Charlemagne,	+ 3.3	+ 4.4	+ 4.9	+ 3.9	+ 4.5	+ 4.2
Harun al Raschid,	+ 2.9	+ 2.5	+ 4.1	+ 2.1	+ 3.9	+ 3.1
Drake,	+ 1.1	+ 1.9	+ 0.9	+ 2.3	+ 2.5	+ 1.7
Joan of Arc,	+ 1.6	+ 0.4	+ 0.8	+ 1.6	+ 1.8	+ 1.2
Champlain,	+ 1.2	+ 1.5	+ 0.8	+ 1.2	+ 0.2	+ 1.0
Richelieu,	- 1.3	- 0.9	- 0.6	- 1.3	+ 0.2	- 0.8
Gustavus Adolphus,	- 2.4	- 1.3	- 1.3	- 2.2	- 2.0	- 1.8
Franklin,	- 0.6	- 1.4	- 2.3	- 1.8	- 3.9	- 2.0
LaSalle,	- 3.1	- 2.1	- 3.3	- 2.1	- 3.5	- 2.8
Mazeppa,	- 4.0	- 4.1	- 3.1	- 3.8	- 3.2	- 3.6

The aim in selecting the names comprised in the list was to avoid such special forms of bias by scattering them widely while ensuring general acquaintance with the characters chosen. The most unsatisfactory single feature of the group is of course

that of Franklin, who is at once the most recent and probably the most familiar of the series. No positive error therefore can ever occur in his case; and the name which would head the list were free displacement allowed appears here in the lower half of the scale. Nevertheless in spite of the change of direction in general interests which comes with age, the plus and minus groups are identically constituted in the two sets of returns. The illusion of relative perspective in time which is established in childhood concerning the great names of the world is neither corrected nor importantly modified in later life.

Several minor points remains to be noted in connection with the results in general. The reader may wish, in the first place, to know the relative magnitude of the average error for each class of objects respectively; in other words, which of these four groups of judgments manifests the greatest influence of secondary bias. This is shown in the following table:

TABLE XV.

Class	Lands	Rivers	Cities	Men	Average
Schools, University,	1.6	2.6	2.4	2.2	2.2
	1.2	1.7	2.0	1.7	1.6
Average,	1.4	2.15	2.2	1.95	1.9

A question may arise as to the nature of the prevailing type of error which gives form to the curves presented in this paper. A single displacement will produce in the results as many individual errors as the number of places it is removed plus one, and all of the series but one will be of the sign opposite to that which attaches to its own error. Thus if the fifth river of the series were put tenth its displacement would be -5 , and the five rivers passed over would each suffer an error of $+1$. The frequency of plus and minus errors, independently of their quantitative values, therefore indicates the tendency which prevails in the judgments. These totals have been made out for the school children in relation to the ages of the pupils as shown in table XVI., which gives the average number of plus errors per series of ten judgments:

The two sexes are given separately, as their average would tend to obliterate the differences which exist. At all ages plus

errors are in the majority among boys, while in the case of girls an excess occurs but once. In so far as the figures have significance boys tend to err through the presence of positive underestimation of the less important members of the series, girls through overestimation of the more important. The intellectual illusion arises in the boy's case from ignoring the things which are of little interest; the girl errs through unduly magnifying the objects which she values. There appears² also in the former case a progressive reduction in the excess of plus errors, which indicates the replacement of fewer and extravagant displacements by more frequent and systematic errors of interpretation.

TABLE XVI.

Class	11	12	13.	14.	15.	16.
Boys,	5.7	5.5	5.5	5.4	5.2	—
Girls,	—	4.9	4.9	5.4	5.0	4.7

In the next place, the influence of these forms of secondary bias is manifested to a greater degree in the reports of school children than in those of university students as shown in Table XV., above, in which the figures indicate the average error of displacement in each series of objects for all observers concerned. In every class of judgments the mature group of subjects shows a more correct apprehension of the actual character and relations of the things compared than do the school children. Better acquaintance with the nature of these things through travel and reading, with possibly a more or less conscious recognition of and allowance for the element of subjective bias itself, has clarified the imaginative representation of them in the minds of the older persons.

Within the series of ages which the school returns comprise no correlation between age and decreasing error can be traced, the indices running as follows:

TABLE XVII.

Age.	11.	12.	13	14.	15.	16.
Boys,	2.3	2.0	2.2	2.5	2.3	—
Girls,	—	2.4	2.3	2.3	2.3	2.8
Average,	2.3	2.3	2.2	2.4	2.3	2.8

The sexes are distinguished by an almost invariable difference in the magnitude of the errors involved. Men are more correct in these classes of judgments than women, and boys than girls. The figures for university students are given in the first of the following tables, those for the school children in the second :

TABLE XVIII.

Classes.	Men	Women
Lands,	1.14	1.25
Rivers,	1.45	2.05
Cities,	2.19	1.94
Men,	1.65	1.74
Average,	1.61	1.72

TABLE XIX.

Class	Boys.	Girls
Lands,	1.59	2.00
Rivers,	2.56	3.20
Cities,	2.57	2.60
Men,	2.23	2.70
Average,	2.24	2.62

This slight but persistent excess of error on the part of girls and women falls in with popular judgment concerning the susceptibility of mind in the two sexes to factors of subjective bias in general. The woman is supposed to be more prone to have her judgment of things and their relations in the external world distorted by the influence of their various symbolic values ; the man is regarded as more objective and impartial in his apprehension of the contents of experience. Man's knowledge is discursive and the manifold aspects of reality are held in relatively independent regard, while in woman's mind the various interpretations of the world tend to overflow and confuse the classifications to which their special points of view give rise.

For the convenience of those who may wish to compare their own series of judgments with the results here presented the various countries, rivers, cities and men are given in correct order in table XX. :

TABLE XX.

Lands.	Rivers	Cities.	Men.
Siberia	Lena	Rochester	Charlemagne
United States	Mississippi	Allegheny	Harun al Raschid
Peru	Mackenzie	Albany	Joan of Arc
Afghanistan	Danube	Camden	Drake
German Empire	Orange	Trenton	Champlain
Italy	Rhine	Harrisburg	Richelieu
Iceland	Petchora	Quincy	Gustavus Adolphus
Ceylon	Douro	Newport	LaSalle
Switzerland	Hudson	Springfield	Mazeppa
Palestine	Thames	Frankfort	Franklin

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