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of
Religion and Ethics

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laws, as a result of their important place in Frankish codes. The Franks soon after their conversion Christianized the element ordeals, one of which had already appeared in the Salic Law (see above, p. 531[a]), but the Church strove against the duel; the Burgundian code, however, persisted in giving special prominence to it, and in the 6th cent. it was again legally recognized. Charlemagne was a convinced upholder of ordeal, especially of the unilateral forms. He recognized the duel, but attempted to replace it by a new form of bilateral ordeal, that of the cross, in which both plaintiff and defendant stood motionless, with arms outstretched against a cross; whichever first moved or let fall his arms was judged guilty. This is obviously a Christian ordeal, but its heathen prototype is found in the *stapfsaken*, or asseveration, with right hands outstretched, described in *de Populi Leg.*, tit. 6 (*M.G. Leges*, iii. 465). The cross ordeal first appears in Frankish law under Pepin (A.D. 753), for a claim of a woman against her husband. In Charlemagne's laws for the Franks it is the test for theft and for disputes of boundaries (*M.G. Capit.* i. 129); for the Lombards he makes it the alternative to the duel (*M.G. Leges*, iv. 511, tit. 130), but for other charges, such as certain murder-charges, decrees the nine ploughshares (*ib.* p. 507, tit. 104). The cross ordeal persisted in Lombard law until forbidden by Lothair in the early 9th cent., 'ne Christi passio . . . cujuslibet temeritate contemptui habeatur' (*ib.* p. 556, tit. 93); Lothair also applied to the Lombards the Frankish decree of his father, Louis the Pious, annulling the cold-water ordeal (*ib.* p. 548, tit. 56; *M.G. Capit.* ii. 16).

In spite of this enlightened attitude, ordeal became so deeply rooted in the popular custom of the two following centuries as to be known in Canon Law as *purgatio vulgaris*. The Church itself relied upon it for the conviction of both clerical and lay offenders (cf. Lea, *op. cit.* pp. 356–363), and was unwilling to forgo a privilege at once so impressive and so lucrative; there was a growing tendency, however, to confine its use to the conviction of heretics, and this use of the iron ordeal was allowed even by the Lateran Council of 1215. In secular usage the practice of it tended to be confined to accusations of unchastity and of conjugal infidelity; thus Richardis, wife of Charles the Fat, and Kunigund, empress of Henry II., both underwent the ordeal of the nine ploughshares. Distrust in the efficacy of ordeal did, however, appear, in spite of this royal and ecclesiastical acknowledgment of it, and in spite of its vigorous defence, supported by Biblical warrant, by Hincmar of Rheims in the 9th century. This distrust found expression in many quarters (cf. Lea, *op. cit.* pp. 348–350), and affects a legal code in the Assize of Jerusalem, where ordeal was allowed only when the accused accepted it voluntarily. It is reflected in literature, both in the courtly epic of Gottfried von Strassburg, where Isolt escapes the conviction of iron ordeal by an oath literally exact, but intentionally deceptive (*Tristan*, i. 15731 ff., *Werke*, ed. F. H. von der Hagen, Breslau, 1823, i.), and in popular realistic poetry, as in the poem where a guilty husband openly practises trickery in the iron ordeal (cf. M. Haupt, *ZDA* viii. [1851] 89–95). Yet these references from German literature are not to be taken as proof of general disregard of ordeal; on the contrary, ordeal persists later in German codes than in those of any other Teutonic nation; thus provision for the duel appears in the *Schwabenspiegel* of the 13th cent. (tit. 340, 359, 360, ed. W. Wackernagel, Zürich, 1840); and for the duel, alternating with the water and iron ordeals, in the *Sachsenspiegel* of the 14th century (i. 39. iii. 21, ed. C. G. Homeyer, Berlin, 1827). In S. Germany forms of ordeal still occur in popular custom perhaps more persistently than in any other country, though often much weakened and disguised.

LITERATURE.—H. C. Lea, *Superstition and Force*[3], Philadelphia, 1878, pp. 240–368; J. Grimm, *Deutsche Rechtsalterthümer*[4], ed. Heusler and Hübner, Leipzig, 1899, vol. ii. ch. vii.; H. Paul, *Grund. der germ. Philologie*[2], Strassburg, 1900, vol. iii. sect. ix. B. 7, § 91 (by K. von Amira); H. Brunner, *Deutsche Rechtsgeschichte*[2], Leipzig, 1892, ii. 399-419; J. Patetta, *Le Ordalie*, Turin, 1890; F. Liebermann, *Die Gesetze der Angelsachsen*, Halle, 1903–12, vol. i. pp. 401–430, vol. ii. pt. ii., *s.vv.* 'Ordal,' 'Kaltwasser,' etc.

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ORDER.—I. Orderliness and its uses.—In dealing with sets or collections that consist of individual objects—sets of objects such as the stars in the sky, the men who are members of a social group, or the articles of furniture that are present in a given room—we may proceed in either of two ways.

(1) The first is the purely empirical way, which we follow when we note each individual object by itself, and then consider its relations to the other objects which belong to the collection. Thus we may take note of various chairs in one room, that one is near this window, another close to that door, and so on. Again, we may notice that, at a given time, one star is visible in the east, another is prominent in the west, and that the north star stands in such and such relations to stars which belong to the constellation called the Great Bear. This method of studying the objects which make up a given collection is of great importance, but, unless it is supplemented, it leaves us without a knowledge of the orderliness of the objects and of the collection which we study.

(2) The second is a way dependent upon our power to discover that the objects of the collection which we have studied are subject to such laws that, when we have observed some of the facts with regard to those objects, we can infer from the knowledge of these facts what may prove to be a multitude of other facts to which the objects of the same collection are also subordinate. In so far as we can effectively draw such inferences, we are able to make the empirical knowledge which we first obtain, and which may be, so to speak, 'ruler over a few things,' into the source of a knowledge which also makes us 'rulers over many things.' That is, from the empirical knowledge which has for its object individual members of the collection which we are studying, we may be able to infer, through general laws known to us, a knowledge relating to other members of the same collection, and, on occasion, to a great many other such objects.

When a collection of objects has characters so subject to law that from a knowledge of some portion of the objects, their characters, and relations we are able to infer what are the characters and relations of at least some of the other objects, it has, in a highly general sense, the character of orderliness. The objects of this collection form in some sense an order, or what is also sometimes called an array. A closer examination shows that there are many different kinds of orderliness and order, some of which are much more important than others. But in the most general sense we may say that a collection of objects possesses order by virtue of the fact that, from a knowledge of what is true of some of its members we can infer in definite ways what is or will be true about the other objects of the collection, or about some portion of them. Order is important for us because, in the first place, by means of such properties belonging to collections we can and do economize the work both of our science and of our conduct in dealing with collections of objects which possess especially the more important kinds of order. Instead of dealing with all the details of a collection of objects, we deal with a portion of the facts, and then use our information to guide our behaviour in dealing with the rest, or with some portion of the objects.

The simplest instance of the value of order is furnished by the distinction between a confused or disorderly collection of men and an orderly array of individuals, such as is represented by soldiers drawn up in battle line, or by officials taking part in a public ceremony. If you look from a window upon a crowd of people in a park or in a market-place, and if they are not notably an ordered collection, you may make the general statement that the lack of order among them is exemplified by the fact that each individual is going his own way, so that, if you want to find out what he is doing or whither he is going, you must watch him for himself; his neighbour's doings may not be in any clearly observable relation to his own. What one is doing does not enable you to infer what others are doing. If, as in many a market-place or street, the people are in various ways imitating one another, and are engaged in common activities, this very fact introduces, as far as it goes, some sort of order into the group. The ebb and flow of the crowd in the market-place or street, if subject to observable laws at all, makes possible the inference that some of those present are leaders in the movements which go on, while others are followers and imitators, that some preside, incite or address the crowd, or offer their wares for sale, while others are followers, or buyers, or are led or influenced by leaders or by the vendors of wares. So far as such knowledge permits you to make valid inferences from the observed facts regarding certain individuals to the observable or predictable facts regarding others, the crowd in question is not a disorderly assembly, or a collection devoid of what may be regarded as its own sort of order. The uninitiated observer who looks down upon the floor of a Stock Exchange finds a general appearance of disorder, or of the lack of order, in the collection of people whom he at first observes. When he is better acquainted with the business going on, and with the way in which it is done, he is able to draw inferences with regard to some of the people and the modes of behaviour represented, while he learns to base his inferences upon what he observes about the people and the conduct that first attracted his attention. The observer gradually learns something about the laws followed by those who do business in the Stock Exchange, while, precisely as his knowledge grows, the people on the floor of the Stock Exchange appear to him more and more as an assemblage of persons having, and engaged in following, a more or less determinate order.

2. Law and order.—It will be observed that, in the sense which we here emphasize, order depends upon the presence of definable law, and varies with the laws which are in question. On the other hand, there is a difference between the lawfulness, or general subjection to law, which may belong to the real world, to our conduct, or to our thought, and that which we call 'order' for the purposes of the present discussion. By 'lawfulness' we mean a character which is generally viewed as belonging, not to individuals or collections of individuals, but to the general modes of behaviour, the general qualities, character, or relations which nature follows, which we regard as belonging to the real world, or which we discover when we contemplate the natural world, the metaphysically real world, or our world of thought or of conduct. But 'order' belongs to sets of individuals, to collections, to arrays of things, persons, deeds, or events. In other words, to use the term first prominently associated with the famous doctrine of Duns Scotus concerning the nature of individuals, order belongs to collections of 'hæcceities,' to groups of individuals, or of objects which are viewed as hæcceities; but laws and lawfulness in general especially belong to our science, thought, and modes of behaviour.

E.g., the planetary motions are subject to Kepler's laws, or to the Newtonian law of gravitation. But the solar system possesses, or is, an order, since there are some facts about planets moving in orbits external to the earth's orbit which can be inferred from this very fact. Thus from the fact that the orbit of Jupiter is related in a well-known way to the orbit of the earth, while the orbit of Venus lies between the orbit of the earth and the sun, we can infer that, on occasion, Jupiter and Venus, as viewed from the earth, appear to be nearly opposite each other, while Jupiter and Saturn, being so related to the earth that the earth's orbit lies between each of them and the sun, cannot appear to us as occupying positions in the sky which are opposite to each other. These simple facts can be inferred from our knowledge of the way in which the orbit of the earth is related to the orbit of these other planets. But such facts and inferences relate to the hæcceities, to the planets in question, and to their real or apparent relative positions as members of the order of the solar system.

In brief, a law of nature is an invariant mode of change which some process, or class of processes, exemplifies. Analogous definitions apply to laws and lawfulness wherever these are present in the ethical or the metaphysical world, or in any world, real or ideal, which is properly to be conceived as subject to invariant modes of change or behaviour. But an order is a set of hæcceities, or of individuals, such that, by virtue of laws to which these hæcceities or their general characters are subject, it is possible to draw the inferences exemplified above from some members of the order to other members of the same order.

The contrast between laws on the one hand and order on the other is easily seen in the ethical as well as in the natural realm. The moral law relates to principles and modes of conduct, and so explicitly to universals. The golden rule, the Kantian categorical imperative, Bentham's maxim regarding the choice of the greatest happiness, are all definitions of supposedly invariant modes of action, ideal types of behaviour, which the moral law counsels for various classes or sorts of moral agents. On the other hand, in a court of law plaintiff and defendant, together with their counsel and the judge, are individuals constituting a determinate legal order. They constitute such an order because, from the fact that we know that somebody, A, is plaintiff, while somebody, T, is judge, and somebody else, perhaps D, is counsel for the plaintiff, we can infer certain other facts, with regard to the functions, interests, duties, purposes, or perils of other actual or possible members of the same court, occupied with the same business.

3. The whole numbers. — One of the most familiar and important instances of order with which the exact sciences are acquainted is the order of the so-called 'whole numbers.' This order is made up of the first member of the order, and then the sequence of numbers represented by the terms three, four, and so on. It consists of an ideally endless sequence of terms whose properties are such that a vast number of assertions can be made with regard to the properties of numbers. These assertions are, ideally speaking, as infinite in their multiplicity as is the series of whole numbers itself. Yet, logically speaking, all the arithmetic of whole numbers can be deduced from the following simple propositions which relate to elementary properties of the order in question:

(1) There is a relation which may exist between two whole numbers, and which is called the 'relation of next successor to.' Thus four is the next successor to three, two is the next successor to one: and, in general, if n is a whole number, the next successor to n is the whole number called $n+1$.

(2) There is a whole number, and one only, which is not the next successor to any whole number. This, also called 'the first whole number,' may be conveniently represented by the symbol 0. The next successor to 0 is then called one; the next successor to one is called two, and so on.

(3) Given any number, n, then its next successor, $n+1$, is thereby uniquely determined, so that, if every whole number has a next successor, every whole number also has but one next successor.

(4) Every whole number, without exception, has a next successor.

(5) If any property whatever is such that it belongs to the first whole number, and if it is such that, if it belongs to any whole number, it belongs to the next successor of that whole number, then this property belongs to all the whole numbers.

From these principles it is easy to show that the series of whole numbers thus defined possesses the property of being what is called 'infinite,' *i.e.*, since every whole number has a next successor, there is no last whole number. In brief, the order of the whole numbers is such that it has a first member and no last, while every one of its members has a next successor, and while it is subject to the principle often called 'the law of mathematical induction'—

the law that permits the so-called 'reasoning from n to $n+1$, and so to all,' in case of orders which have the same properties as those of the whole numbers. Orders of this kind have been called by A. N. Whitehead and Bertrand Russell 'progressions.' They are of enormous importance for all the exact sciences and for the whole progress of the human mind. It will be observed that one can exemplify the order of the whole numbers by considering a very few, such as zero, one, two, three. When one thus becomes aware of the general laws to which the whole order is subject, one can deduce not merely countless theorems belonging to the arithmetic of the whole numbers, but countless properties exemplified by whole numbers not mentioned in the foregoing elementary example. The orderliness of the whole numbers and the properties both of the individual members and of possible groups of members thus become deducible from the principles just stated, and from whatever experience we have for knowing or for asserting that the order of the whole numbers is actually exemplified in the real or the ideal world. How important this knowledge of order may be we can realize if we remember how groups of individual objects or men can be arranged so as to correspond to some portion of the whole number series, while such an arrangement is useful in guiding conduct and reasoning in the most significant ways. The heads of a discourse, the stages of a plan of action, the officers or dignitaries of a given hierarchy or other numerically ordered array of individuals, the deeds of a life, the hours of the day, the days of the year, the watches turned out by a manufacturer, may be either arranged or labelled by a set of whole numbers. Such an arrangement is useful for the most manifold purposes, in planning, seeking, or using objects, or in bringing individual human beings into co-operation.

4. Further illustrations.—There are cases in the realms of science, art, and life in which we deal very extensively with laws and lawfulness without paying attention to the orders in which these laws find their concrete exemplification. Thus, while our account of any given instance of order always involves a recognition of certain laws to which the members of the order are subject, we can have elaborate exposition of theories which deal with laws and their consequences in general terms, while largely neglecting to emphasize those orders in which the laws get many highly important and concrete illustrations. Thus the science of mechanics deals with the laws of motion under conditions very often conceived as ideal; and, in so far, that science does not tell us about the natural order of the physical world. For astronomy the order of the solar system has a certain primary interest, at least from one mode of approach. Newton's *Principia* dealt in considerable part with the laws of bodies subject to gravitation, and, in so far, did not lay stress upon the order of the solar system, but upon the laws of planetary motion and of the motion of bodies in general.

On the other hand, where our discussions relate to general laws and do not primarily lay stress upon the concrete orders that we find existing in the real or ideal world, then, in so far as they are exact and well reasoned, they inevitably include a more or less extended description of systems of ideal objects — conceptual embodiments, so to speak, of the laws the logical or the rational principles of which we are making use. In this sense any exposition of the laws to which the natural or the moral world is subject inevitably includes a presentation of some ideally ordered system of conceptual entities, of numbers, of possible deeds, or of other objects, whose array illustrates those laws with which we are dealing. Once more, the instance of the whole numbers serves to illustrate what happens when we reason about the laws of nature, or of the ideal or moral world. If the watchmaker labels his watches with numbers that stand for the order in which they were turned out of the factory, he constructs an ordered system of hæcceities. This may be convenient for the process of finding lost watches, or of registering the purchase or the fortune of individual watches. On the other hand, if a man deals, as the arithmetician does, with the laws of whole numbers, he inevitably makes use of the ideal order of the whole numbers themselves. This order is constituted, not by the principles of the arithmetic of whole numbers cited above, but by the ideal hæcceities, called the whole numbers themselves. On the other hand, every study of a system of law, as it becomes explicit, involves the definition of an orderly system of ideal hæcceities, which exemplifies the laws in question. Thus the relations of law and order become more obvious and definite in our discussion. The maxim, 'Order is Heaven's first law,' gets at least one possible and fairly definite interpretation. Viewing heaven as a realm whose members are hæcceities that belong to a world which our experience does not at present at all adequately cover, we, in faith, or in hope, regard these hæcceities as having a certain array. This array will also exemplify justice, the true values which our human life was intended either to exemplify or, in heaven, to attain. The distinction between the law and the order will be perfectly clear, precisely in so far as the laws are understood, and in so far as, in the heavenly world, the order will be needed, since in heaven justice will exist, not merely as a principle, but as the concrete order of the 'just made perfect.' Possibly the law of heaven may be, as St. Paul maintained, the law of charity. But the order of heaven will then be the order of the concrete individuals whose spiritual unity, with one another and with their Lord, the Apostle so eloquently characterizes.

5. Series and the correlation of series.—The term 'series' has already been explained by the endless ideal series of the whole numbers; but there are many other series besides. We early become familiar with a new type of series when we study 'fractions,' better named 'rational numbers.' The rational numbers—*e.g.*, decimal fractions—form a series, in so far as we take account of the fact that two decimal fractions or other rational numbers which are equal to each other may be treated, for certain purposes, as if they were identical. Thus the fractions $\frac{1}{2}$, $\frac{2}{4}$, $\frac{4}{8}$, and the decimal fractions ·5, ·50, ·500, and so on, are all mutually equivalent. We may regard them, therefore, as all different representations of the same fractional value. If we confine our attention to those rational numbers called 'proper fractions,' *i.e.* those which lie between 0 and 1 in value, we may notice that the series of the proper fractions has the following character:

(1) When two proper fractions are distinct, *i.e.*, when they do not possess equivalent values, there is a relation existing between them which is very familiar and possesses decidedly important properties. This may be called 'the relation of greater and less,' *i.e.* in the case supposed one of the fractions is the greater, while the other is the less of the two.

(2) The relation of greater and less is not a mutual relation; as the logicians sometimes say, it is asymmetrical. If a proper fraction P is greater than a proper fraction Q, then Q is never greater than P, but stands to P in what we call the relation 'less than.' The relation 'less than,' like the relation 'greater than,' is an asymmetrical relation. Each of these relations is the inverse of the other, and is, in a way, opposed to it in 'sense,' or in what may also be regarded, from a certain point of view, as 'direction.'

(3) If we choose any two rational fractions, r and t, which are not equal to each other, then there is always to be found in the series of rational numbers a third rational number which is distinct both from r and from t. Let us call this third rational

number s. Now s may be, as the third member of this class, so chosen that s is greater than r and less than t. In this case we may say that 's lies between r and t in the series of rational fractions.'

(4) If we choose to regard 0, not as one of the rational numbers, but as lying before all the rational numbers, and forming the inferior one of the two extremes between which all the proper fractions lie, while 1 is the superior extreme, then, as we can readily see, there is no proper fraction which is the least of all the proper fractions. For a perfectly analogous reason the series of rational fractions has no greatest member, since, whatever proper fraction we choose, such as ·9999, we can always find a proper fraction which is greater than this chosen fraction, and which is nevertheless not equal to 1, so that it lies between the proper fraction which we just chose and 1.

(5) To sum up, the series of proper fractions possesses these properties: any two of its distinct members stand to each other either in a certain unsymmetrical relation of the first to the second or in the converse of this relation, so that of two proper fractions a determinate one is the greater, while the other is the less. Between any two rational fractions we can always find or determine a third which is greater than one of the pair and less than the other. There is no rational fraction which stands first in the series of proper fractions, and no rational number that stands last. The series of proper fractions has, in this sense, neither beginning nor end. Yet, if we choose, we can regard 0 and 1 as extremes so related to the entire series of the proper fractions that 0 precedes all of them, despite the fact that there is no first member in the series of proper fractions, while 1 follows all of them, despite the fact that there is no last member in the series.

(6) Last of all, we may mention a property of the 'greater-less' relation which is of cardinal importance for establishing and determining the characters which belong to the series of proper fractions. This property is expressed by saying that, if there are three proper fractions such that b is greater than a, while c is greater than b, then c is greater than a; *i.e.* the relation 'greater than' is not only asymmetrical, but is also what logicians call 'transitive'; it is a relation which passes over from pair to pair, or which follows what William James, in the closing chapter of his *Principles of Psychology* (London, 1901), calls 'the axiom of skipped intermediaries.'

The simple but highly abstract example of the series of proper fractions has, as we now see, characters which sharply distinguish it from the series of the whole numbers, in which there is a first although no last member. Corresponding to every member, n, there is its next successor, $n+1$. On the contrary, the series of proper fractions has no first and no last member, while none of its members has either a next predecessor or a next successor. Yet the two series have certain notable features in common. In each there is a relation, which we may call 'the relation of successor,' whose converse may be regarded as 'the relation of predecessor.' This relation, so long as it is viewed as between two members of a series which are not of equivalent value, rank, or place, is unsymmetrical and transitive. We can say that, given two proper fractions which are not mutually equivalent, one is a successor of the other, in the same way in which we may call one of them greater than the other; and, if we choose two whole numbers, so long as they are not equivalent whole numbers, one of them is, in the whole number series, a successor of the other, while the other is a predecessor of the one. Different as the two series of whole numbers and proper fractions are, they still possess common and relational characters, which make both of them series. This may be viewed as a general characteristic of all those series which, like the points on a straight line in ordinary geometry, the events in a story or in a man's life, the members of a file of soldiers, or the positions of a heavenly body as it seems to move from a point in the eastern horizon to a point where it disappears in the western horizon, are possessed of the character of being 'open series,' *i.e.* series which do not return into themselves, and which possess no repetitions of a member.

Open series are of enormous importance for the whole theory of order. The events of time, so far as these are known to us, form open series. No event recurs. In like manner, any physical process which follows, more or less definitely, the course of an open line, be it straight or curved, presents the features of an open series. The movements of a man, when he walks once over a road and does not return, or cross his own tracks at any point, form an open series. All our business, all our plans of life, all that makes our life a progress or the reverse, all that gives ethical significance to a personality and to its activities, are things depending upon the character of the open series. In the light of the foregoing instances, we may now give a definition of the order of an open series.

Let there be a set of objects, S. The objects may be physical or ideal, theoretically or practically significant—points, numbers, deeds, people, or whatever you will. Let the members of S be subject to the following general law:

If we choose any two members of S, there will be a relation which in some way has already been exemplified by the relation 'greater and less.' This relation will apply uniformly to whatever pair of the members of S is taken into consideration, with this sole proviso, that, if you call it 'the relation G,' and if you consider two members p and q of G, then a determinate one of these two members of S, *i.e.* either the member p or the member q, will stand in this asymmetrical and transitive relation G to the other member of the pair. Since, by hypothesis, the relation G is asymmetrical and transitive, if p stands in relation G to q, q will not stand in the relation G to p, but in the converse of this relation.

If all the members of S are subject to this general law, the members of S stand in the order of an open series, and actually constitute such a series. The two cases of the whole numbers and the proper fractions are instances of such a serial order.

In the form of a definition, this account of the order of an open series may be stated thus: by an 'open series' is meant a set, or collection, of objects, so that there exists, or is definable, some one relation, G, asymmetrical and transitive, such that whatever pair, p and q, of the members of the set be chosen, one, and of necessity only one, of them stands in the relation G to the other, while the other inevitably stands in the converse of the relation G to the first.

It is obvious that an open series conforms to our definition of what constitutes order. It is a set of objects. From some assertions regarding members of this set other assertions can be inferred. The series consists of individuals, while the asymmetrical and transitive relation, upon which each instance of a series depends, itself exemplifies a very general relational law. That the members of the series themselves illustrate this law makes it possible to infer from the relations of some of them certain relations belonging to others.

In the actual work of the sciences as well as in the formation, control, and use of serial orders, a large part is played by another set of relations, to which we must call attention in passing. In general we define various distinct series, if we have occasion to define any one series. Thus the series of the whole numbers is usually defined, not merely in the highly general and abstract manner just referred to, but more concretely, namely, in connexion with such a process as the counting of objects, or the numbering of watches, or, again, in connexion with the study of the laws of nature. The series of the proper fractions is both theoretically and practically used, not merely in dealing with abstract arithmetic, but in the processes of measurement. Concretely the proper fractions become useful to us when we are considering an ounce as a determinate subdivision of a pound, measurable by means of a certain proper fraction, or a foot as a determinate part of a yard. In other words, the abstract series of order, such as are exemplified by our proper fractions and our whole numbers, get their more concrete, and in general their more practical, significance when they are brought into relation with other series.

Now the operation of connecting a serial order like the whole numbers with an ordinary process like the counting of individual things is a special instance of what logicians often call 'correlation of series.' A set of individual objects stand before me. I need, for various purposes, to count them, to know how many of them there are. I do this by using the series of whole numbers, treated, for the purposes of counting, as an order. I consider the concrete set of objects so that, by means of pointing, labelling, or some such process, I attach, in due order, each one of my whole numbers to the members of this collection, continuing until every one of the objects to be counted has been pointed at, or labelled, by one of my whole numbers. Then I regard the last one of the whole numbers of which I make use for this purpose as letting me know how many members the collection of objects which I have been counting contains.

When we are dealing not merely with collections which we can count, but with collections which we measure, we have frequent reason for correlating such series as those of the rational numbers with the various real quantities—with length, distance, weight, size, and so on. The operations upon which such correlations depend in many cases are of great complexity. Our present interest lies in the fact that by means of such processes we get our knowledge of the measurable facts of our natural world into order, and that we do so by correlating the observable or measurable series of lengths, distances, and other measurable objects, with our already known ideal and logically defined serial orders. By means of such correlations the ideal order of the abstract numbers—*e.g.*, of the whole numbers, of the rational numbers—comes to pervade, to dominate, or, as one may sometimes say, to infect, the at first less orderly or even apparently disordered world with which our experience has to deal. Order is thus correlated with the facts which the real world presents to our notice, and which experience presents to be operated upon by our processes of counting, measuring, or otherwise applying our ideal series, such as whole numbers or rational numbers, to the objects of our experience. Through such correlation our conduct gets an orderly organization, which constitutes one of the most general and important consequences of our scientific study of the world. Instead of dealing with a world which seems one of chance facts, we discover what appears to be a world well arrayed, or at any rate capable of being controlled by serially ordered, precisely defined modes of action. The discovery of the whole number series was one of the first advances of the human mind in the exact sciences. All our discovery of order in nature, and all the orderly serial arrangement of our lives, ideals, and social order have been influenced by the whole number series, ever since we learned how to think in terms of this number series. Thus man first discovers order in the form of series of ideal objects, which are, indeed, suggested to him by the real world, but which he learns to understand through such constructive and ideally orderly activities as those which counting and measuring represent. Thus, by means of correlation, man continually introduces order into his real world, and is stimulated by whatever he finds orderly in that world to an effort to increase his own power to construct and to understand orderly series and their correlation.

6. Order in the moral and social world.—The foregoing accounts of instances of order as we find them in the regions with which our theoretical science deals illustrate the fact that, in so far as we take account of order, we not only gain a theoretical control over our knowledge of facts, but prepare ourselves for forms of practical activity which are made possible through the recognition, the definition, the production, and the control of order. The rows, the series, the array of real and ideal objects with which our science deals acquire their importance for us in close connexion with two principal facts, which result from the very nature of order.

(1) In so far as we are dealing with a collection of objects which, when taken together, constitute an order, we at every point economize the processes of our knowledge, and consequently make it a more powerful instrument for grasping the facts of nature and the connexions of the universe; for it is of the very nature of an order that, from a knowledge of a part of the system which possesses it, we can infer what is true about other parts of the same order, and, upon occasion, about the whole of the order. The general concept of material order, and of the correlation of series, has shown us how, wherever series are known to us and can be systematically correlated, we can constantly make use of some of our knowledge about the facts with which we deal to infer properties without which the advance of our knowledge would be greatly impeded.

It is customary to suppose that the most important concept of the exact sciences is the concept of quantity. That it is the characteristic work of the intellect to be guided by the effort to describe the world in quantitative terms—this is a thesis which has played a large part both in the theory and in the criticism of the work of the human intellect. The well-known Bergsonian criticism of the office and limitations of the intellect is founded upon a tendency to interpret the work of the exact sciences as, in large part, an effort to define nature, as well as reality in general, in prevailingly quantitative terms, so that, from this point of view, the intellect primarily measures, weighs, or otherwise quantitatively defines its task and its material. But this way of viewing the tasks of the intellect is as unjust to the logic of the exact sciences as it is unable to define the actual range which the conception of order has in the guidance of our practical, and, above all, our ethical life.

The quantitative sciences are indeed of very great importance. But their importance is due to the fact that the quantities are subject to certain very interesting laws and types of order, which hold true for many other real and ideal systems besides those systems which the quantitative sciences study and which the arts of measurement make prominent. The science of mathematics is ill-defined as the science of quantity. On the other hand, what gives the quantitative sciences their mathematical importance is the fact that in the realm of quantities there are certain peculiarly interesting types of order present. But these quantitative types of order are not the only exact types of order. Modern mathematical science is interested in a vast number of order types, and of orderly structures in general, which are in their nature not quantitative, and which can be neither defined nor studied in terms of quantitative relations. Geometry, by virtue both of its original name and of a good deal of its actual history, appears to be, upon its face, the science that deals with space measurement—*e.g.*, with the measurement of lengths, areas, volumes, and similar objects. Bergson has been deceived by this aspect of it into calling our geometry 'a geometry of solids,' and into supposing that the pre-eminence which geometry has attained in our physical sciences, and which in consequence the concepts that depend on measurements have possessed in the development of all our philosophy, is due to the evolutionary accidents which have bound the human intellect to a dominant interest in the construction of solid bodies.

As a matter of fact, however, it is not an anti-intellectual tendency, but a profoundly logical interest in the purely orderly, and in the primarily non-quantitative aspect of things, that has come to be expressed in what is technically called 'non-metrical geometry.' Such a geometry science possesses in the branches of mathematics which are called 'projective geometry' and 'descriptive geometry.' These can be very highly developed without making any use of the idea of measurable geometrical quantities. Their source lies not in our power to measure, to weigh, and muscularly or mechanically to manipulate solids, but, as F. A. Enriques of Bologna has shown, in our sense of sight, in our power to notice the orderly alignment of points and sets of points, and the orderly intersections of systems of lines, as such intersections appear in the field of vision. This non-metrical or ordinal geometry may, therefore, be called 'visual geometry.' In fact the eye gives us a certain knowledge of order, distinct from that which we get through our muscles, or through various operations of measurement and metrical comparisons. The ordinal properties of the field of vision have an importance which the logic of science has neglected until recently. It is the eye that, despite all its illusions of perspective, has shown to man, from very early in his career, the distinction between heaven and earth, and the order of the heavenly movements themselves. In this sense the eye has played a large part in man's development in the conception of order. Furthermore, it is the purely ordinal aspect of the series of whole numbers and of rational numbers that lies at the foundation of some of the most important conceptions and theories of arithmetical science. In sum, then, the essence of the exact sciences lies in the fact that they reveal, as well as use, order, while quantity and the realm of the quantitative furnish only a special instance of order, not the only instance, and in certain respects by no means the most theoretically fruitful instance.

(2) With these considerations in mind, we shall now be able to make a transition to the types and the nature of order which have the greatest interest in the moral world. As we have just seen, the order of the heavenly motions proved to be of great importance in giving men a conception of the kind of order that ought to prevail in a justly organized moral and social world. From the first, then, human conceptions of order have had as genuine a moral and social as a scientific and theoretical significance. The one great task of the intellect is to comprehend the orderly aspect of the real and of the ideal world. The conception of order lies, therefore, just as much at the basis of an effort to define our ideals of character and society as at the basis of arithmetic, geometry, or the quantitative sciences in general, or of those non-quantitative types of exact science which are now on their way to higher development. It is, therefore, not a matter of mere accident or of mere play on words that, if a man publishes a book called simply 'A Treatise on Order,' or 'The Doctrine of Order,' we cannot tell from the title whether it is a treatise on social problems or on logic and mathematics, whether it deals in the main with preserving an orderly social order against anarchy or with studying those unsymmetrical and transitive relations, those operations and correlations upon which the theories of arithmetical, geometrical, and logical order depend. The bridge that should connect our logic and mathematics with our social theories is still unfinished. The future must and will find such a bridge. Then exactness of thinking will become consistent with the idealizing of conduct; the realm of the Platonic ideas that are to guide man in his search for wisdom will be conceived, at least in part, in terms of an order which will not be 'ageometrical'—not foreign in type to the sort of order which the geometricians, especially in the non-metrical part of their work, have long had reason to study. It only remains now to mention some ethical and social relations among human beings which are of importance in enabling us to infer from known facts about given human individuals what the duties, offices, and social rights and positions of other individuals either are or may become.

Among the moral and social relations of human beings there are a number of dyadic relations well known to us as furnishing a basis for serial order, and as being useful in both the lesser and the greater matters of social life. Thus the relation of superior and inferior in cases where authority is concerned enables us to define serial order. If A commands B, and B commands C, and if orders can be transmitted from pair to pair, then, in general, or under more or less precisely definable conditions, the commands of A may pass, as we often say, indirectly, through his subordinate B to B's subordinate C. In such cases it may be as well for A to transmit his commands through B to C as to express his authority directly. How far such a series may extend and how many terms it may have will vary with the type of authority in question, with the range of its application, and so with the number of members who constitute the series. But, as far as the order goes, its essential characteristics are the same as those exemplified by a selected series of ordinal numbers, such as 3, 4, 5, 6. The usefulness of the idea of order is strictly analogous in the two cases. The significance of the series consisting of an officer and his subordinates, their subordinates, and so on, lies in the fact that, from a knowledge of some of the facts relating to the persons in question and to their authority, the relations of others of the facts can be deduced, and thus what is called an orderly mode of activity can be predetermined.

A relation decidedly different from that of authority, but of great practical importance, is that of some one who writes a letter, hands it to a messenger, who in his turn passes it over to some predetermined receiver of messages, while the process of indirect transmission is thus continued in an orderly way, until the letter reaches its destination. Such indirect but orderly transmission of messages may be as effective for purposes of communication as if the writer gave his letter to his correspondent without the use of intermediaries. Of such orderly transmission the conveyance of correspondence through the Post Office is a familiar example. What is essential to this sort of order is that, since from some facts you can, in an orderly system, deduce the existence of other facts, the whole undertaking of transmitting information, or other contents of letters, becomes definite, and, subject to the well-known fallibility of human conduct, predictable. The whole business world depends for the order of its transactions upon systems of organization which involve this serial order. Civilized man does most of his work through intermediaries. He pays a foreign creditor a debt by drawing upon his own local bank. He purchases in a distant part of the world by transmitting his orders through all sorts of indirect channels. What he needs to know in order to guide his actions reasonably is the same sort of thing as a student of non-metrical geometry has to recognize when he draws conclusions about an orderly array of points, or the arithmetician computes when he casts up sums of columns of figures; *i.e.*, the civilized man, like the arithmetician, uses in his business, as the mathematician uses in his computations, some order system. It is an order system because a knowledge of part of the facts regarding its constitution enables us to reach a knowledge of other facts. In reaching this conclusion we use general principles. So far as these are exemplified by some system of individual men, of individual acts, and, in general, of hæcceities, that system is an order system. Its order has for us the value that hereby we are able to arrange our modes of conduct and to predict their outcome.

As in the mathematical, so in the moral and social systems, that form of order called 'serial order' is especially familiar and important. But, wherever the system with which we deal enables us to compute, with greater or less probability, some of its facts from others supposed to be given, we are dealing with an order system.

In general, we may say that, since it is essential to order that we should be able to draw conclusions which to us are novel from knowledge about the relations of certain facts given, the most familiar features of an order system will be those which have been illustrated by the transitivity of the various pairs of members belonging to a given series.

We may say that, if by the symbol R $(a\ b\ x\ y)$ I mean simply the assertion, 'The hæcceities, a, b, x, and y, stand in some relation which I call the relation R,' and if by the symbol S $(c\ d\ x\ y)$ I mean the assertion, 'The hæcceities, c, d, x, and y, stand in the relation S to one another,' and if I am able to conclude that, in the system of objects of which I am speaking, the assertion is true that the hæcceities, a, b, c, and d, stand to one another in the relation T, so that, using analogous symbols, I can write T $(a\ b\ c\ d)$, and if general laws of this sort are true of the whole system with which I am dealing, then that system is in some sense an ordered system, although the property of the relations upon which I lay stress is a relational property that permits some sort of elimination. Were the laws of this elimination sufficiently known and sufficiently general, they would permit definite knowledge and, on occasion, definite courses of action, which might rival in their orderliness the states of knowledge and courses of action which we have illustrated by the instances of the numbers and similar mathematical objects.

Such laws may be social. Were it the law of some social order that, if a, b, x, and y belong to the same social club in a great city, and if c, d, x, and y meet in the market-place of the city on a given day, as a fact a, b, c, and d will all bow to one another, and will all take off their hats, then that social order would be subject to a law which it might be worth while to know, and which would certainly give us a right to say that a, b, c, d, x, and y were, at any rate for the time in question, an orderly assemblage of persons. The order in question might not be of an externally peaceable sort. Thus we might suppose an assemblage of men subject to the law that, if a, b, x, and y fought side by side in the trenches, and if c, d, x, and y fought in opposed trenches, a, b, c, and d would, at the earliest opportunity, fraternize and cease fighting. This assemblage of men would be subject to a sort of order. The law characterizing this order might be stated in the form that, in some definable class of instances, the comrades of certain opponents would, at the earliest opportunity, fraternize. However strange the law, it would have some sort of importance if it could be stated and put into application in some determinate manner.

Now in social and ethical matters, quite as much as in mathematical and natural matters, wherever there are laws which permit such eliminations, there is some sort of order in the system characterized by the presence of such laws. To conceive a world in which there is such order is to conceive what makes possible the realization of those ethical ideals most characteristic of organized communities. If an organized and orderly community either exists or is in process of making, we can be loyal to it. For in such a community the individual can devote himself to activities whose fruit does not merely remain his own, but falls to the lot of the other hæcceities with whom he is bound by relational ties. Order, therefore, or at least possible order, is the condition upon which depends the existence of anything lovable about our social system. If each acts only as an individual, the mere fact that he happens to be benevolent does not render his benevolence other than capricious. Loyal activity, on the other hand, is always orderly, since it involves acting in ways that are determined not merely by personal desires, or by the interests of other individuals, but by the relations in which one stands to those other individuals. Paying one's debts is a loyal act, as far as it goes. But it is an act which has no meaning for me unless I can recognize the relation of debtor and creditor. If I am not loyal, I say, in substance, 'I will do this if I choose to do it.' If I am loyal, I say, 'I do this in case my relations to others in the community require me to do thus and thus.'

It is possible, no doubt, to recognize relations without possessing the richer spirit of loyalty. Barren intellectualism is as possible in ethics as in our view of reality. But the essence of loyalty is that from the value of our relations to some things —*e.g.*, to some individuals or hæcceities—we are able to discover something about the value of our relations to other things. Loyalty which can draw no conclusions, which cannot reason from one's interest in certain hæcceities and certain relations to some practically important inference about one's relation to other hæcceities and other social ties, remains blind and dumb, a mere sentiment, like the luxuriantly sentimental altruism of a Rousseau, sending his own infant children to the foundling hospital, or of a Shelley, lyrically delighting in the sacrifice

> 'Of one who gave an enemy
> His plank, then plunged aside to die'
> (*Prometheus Unbound*, act i.),

while he ruthlessly abandons Harriet Westbrook to commit suicide, 'when the lamp is shattered,' and 'the light in the dust lies dead.'

It is essential to loyalty to draw conclusions, to live in a moral and social world which is, at least in some respects, conceived as orderly. In this sense the idea of order lies at the basis both of the ideal and of the life of any community in which loyalty is possible.

7. Law, order, and negation.—Order, as we have said, is closely connected with law. Law is some aspect of our real or ideal world which permits us to draw inferences. It is fairly obvious that, when we know a law in terms at once general and exact, we are able, granted the suitable data, to draw a series of inferences; *i.e.*, if certain premisses logically warrant a certain conclusion, then, in general, this conclusion may be made the basis of further inferences, which indirectly follow, through the form of reasoning which the traditional text-books of logic call a 'sorites,' from the premisses with which we started. As, in a well-ordered commercial system which includes a series of banks or other agencies for the transmission of payments, one is permitted to pay one's debts more simply, and in a more convenient way, by paying one banker, who transmits some negotiable paper to another banker, and so on to the end of the series, so, wherever an orderly system of computation, rational investigation, or definite inference in serial order is possible, one reaches conclusions which may be important by means of intermediate steps of reasoning, by orderly change of premisses and conclusion. In the case of the reasoning process the series may be interwoven in the most complex manner. In the exact sciences they are so interwoven. The order in that case is not merely an order of a simply serial type. The total result of the interwoven systems of series of inferences whereof the exact sciences consist is the development of a richer and richer system of order. The results of an old investigation become the basis of a new inquiry. One branch of exact science becomes interlaced and combined with another. What is characteristic of the process is that, whatever forms of synthesis appear, inference is everywhere an ally and an instrument both in defining and in attaining at once the conception of order and the orderliness of the system with which one deals. In consequence it is one of the laws of the more purely theoretical sciences that, whatever special motives determine their development, they constantly tend to produce a richer wealth of orderliness in our own system of ideas. Upon each new stage of orderly conceptions new forms of order and of orderly systems are based. Where the methods of the inductive sciences enable us to recognize that these mathematically definable types of order have their corresponding systems of facts in the real world, our theories, developed by the process of inference, become more and more widely applicable to our understanding nature, so that the world seems to us more and more orderly. In so far as, at any point of our mental development, we see ways of creating facts and systems of facts, social orders and systems of social orders, which correspond to the ideas which we have so far organized, our moral and social worlds tend to become more orderly.

In brief, our power to infer, in the world of theory and of practice, both accompanies and, where it is limited by our ignorance or lack of intelligence, in its turn limits our power to conceive ideal order and to understand the order of nature, and, finally, our power to give to our lives that orderliness which can win and hold our loyalty and render our life that of the spirit. And that is why the maxim, 'Let all things be done decently and in order,' is no mere expression of pedantry or formalism, but an ideal maxim, whose practical and religious significance finds its principal limitation in our ignorance or inability to give expression to our orderly ideals.

Order, then, is known to us through inference; *i.e.* the orderly is that which corresponds, in the real or the ideal world, to what we infer when we systematically draw conclusions from premisses. Therefore the understanding of the inmost nature of order logically depends upon understanding the relations on which our power to infer rests.

We may sum up with the observation that, if we had no exact idea of what inference is, we should have no exact idea of what order is, while our very idea of what inference is depends, in all cases where an inference relates to classes and to general law, upon our idea of what constitutes the negative of a defined class of objects or cases. Without negation there is no inference. Without inference there is no order, in the strictly logical sense of the word. The fundamentally significant position of the idea of negation in determining and controlling our idea of the orderliness of both the ideal and the real world, of both the natural and the spiritual order, becomes, in the light of all these considerations, as momentous as it is, in our ordinary popular views of this subject, neglected. To the article NEGATION we must, therefore, refer as furnishing some account of the logical basis upon which the idea of order depends. From this point of view, in fact, negation appears as one of the most significant of all the ideas that lie at the base of all the exact sciences. By virtue of the idea of negation we are able to define processes of inference—processes which, in their abstract form, the purely mathematical sciences illustrate, and which, in their natural expression, the laws of the physical world, as known to our inductive science, exemplify. Serial order is the simplest instance of that orderly arraying of facts, inferences, and laws upon which, on the theoretical side of its work, science depends; while, as we have seen, in the practical world, the arraying, the organizing, of individual and social life constantly illustrates, justifies, and renders spiritually precious this type of connexion, which makes our lives consecutive and progressive, instead of incoherent and broken.

Relations of the general type of 'correspondence' enrich and interweave the various serial orders which nature, as well as our ideas, life as well as theory, present to our knowledge. If order is only one aspect of the spiritual world, it is an indispensable aspect. Without it life would be a chaos, and the world a bad dream. Loyalty would have no cause, and human conduct no meaning.

When logically analyzed, order turns out to be something that would be inconceivable and incomprehensible to us unless we had the idea which is expressed by the term 'negation.' Thus it is that negation, which is always also something intensely positive, not only aids us in giving order to life, and in finding order in the world, but logically determines the very essence of order.

LITERATURE.—Hegel's *Logic*, both his briefer statement in his *Encyclopädie*[3], Heidelberg, 1830, and his much longer discussion in his *Larger Logic*, vols. iii.–v. in his collected *Werke*, Berlin, 1832–40, treats the idea of negation at length, but does not clearly see in what relations negation stands to order. The first really modern treatment of the conception of order is contained in Bertrand A. W. Russell, *Principles of Mathematics*, Cambridge, 1903. A much fuller discussion of various mathematical aspects of the concept of order appears in A. N. Whitehead and B. A. W. Russell, *Principia Mathematica*, 3 vols., Cambridge, 1910–13. A considerable number of modern treatises on geometry give an account of so much of the concept of order as is especially important for the understanding of projective geometry. J. Royce has a summary discussion entitled 'Principles of Logic,' in the *Encyclopædia of the Philosophical Sciences*, Eng. ed., London, 1913; here logic has been defined as 'the science of order,' and some of the considerations which are used in this article have been somewhat more technically stated in vol. i. pp. 67–120.

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ORDINAL. — See ORDINATION (Christian), PRAYER, BOOK OF COMMON.

ORDINATION (Christian).—By this term is meant the manner of admission of persons to ministerial office in the Christian Church. For methods of appointment (such as election or nomination) see LAITY; for the ordainer see MINISTRY (Early Christian). This article has to deal only with the liturgical side of the matter, *i.e.* with the ceremonial and forms used in admission to the ministry in the various Christian communities in the world in ancient and in modern times.

1. First six centuries in East and West.—(*a*) *Phraseology.*—It is necessary, before we discuss the customs of different ages and countries, to consider the words used for admission to the ministry. We find that, just as there was a considerable fluidity of nomenclature in the names of the ministerial offices in the earliest Christian period (see MINISTRY, § 2), so in the succeeding ages there was no fixed terminology for 'ordination.'

One of the most common forms of expression was to speak of 'appointing' ministers, and their 'appointment' (*καθιστάνειν* or *καθιστᾶν*, *κατάστασις*); so in Ac 6^{3} of the Seven, in Tit 1^{5} of presbyters, in He 5^{1} 7^{28} 8^{3} of the Jewish high priest, in Clement of Rome (*Cor.* i. 42) of 'bishops' and deacons, in the 10th canon of the Council of Antioch *in Encæniis* (A.D. 341) of readers, subdeacons, and exorcists, in Eusebius, *HE* vii. 9 (*κατάστασις* used with, and as equivalent to, *χειροτονία*), in Athanasius (*Apol. c. Arian.* 11 f.), and elsewhere; and in the Church Orders this mode of expression is used of any order from bishops downwards, though at Antioch *in Encæn.* (as above) it is used of the minor orders in contrast to the word *χειροτονεῖν*, used of bishops, priests, and deacons (for the references in the Church Orders see A. J. Maclean, *Ancient Church Orders*, p. 78). We find the expressions 'to ordain,' 'ordination' (*χειροτονεῖν*, *χειροτονία*), especially but not exclusively of the three higher orders, as at Ancyra (can. 13; A.D. 314), Nicæa (can. 19; A.D. 325), Antioch (as above), Neocæsarea (can. 9; A.D. 314 or a little later), and frequently in the Church Orders; these words do not necessarily imply laying on of hands, and sometimes mean election (properly by a show of hands) or even appointment only; but they do not negative the laying on of hands. In Ac 14^{23} this verb is used of 'appointing' presbyters by Paul and Barnabas, but there is no indication here that it means the act of 'ordination,' though we can scarcely doubt that the way in which they appointed presbyters was by such an act (see *DAC*, art. 'Ordination,' § 1). So in the *Didache*, 15 (*c.* A.D. 130?): 'appoint (*χειροτονήσατε*) therefore for yourselves bishops and deacons.' In the *Apostolic Canons* (*c.* A.D. 400), *χειροτονεῖν* signifies an ordination service over bishops, presbyters, deacons,