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Charity, or the law of life, is conformity to order. One's special service is true charity; faith alone is of no avail. Man on account of his past must be turned from controlling self-love and thus born anew. The two sacraments of Baptism and the Eucharist are perfect correspondences, and therefore highly useful as embodying the new life entered upon and continued.

The materialistic misunderstandings of the middle ages, when primitive Christianity was corrupted by priestcraft and strife, supposed a second personal Advent and a physical end of the world. A truer understanding perceives rather the end of that perverted or Babylonian state of things, and a renewal of Christianity by a revelation of the true meaning of the Divine word by means of a well-prepared mind.

Swedenborg regarded himself as having been led all the way towards the accomplishment of this unique service, and in the performance of it he was placid and modest. He published books at his own expense. He put no name on them until near the last. He lived unmarried and frugally. To secure liberty of the press he made several journeys to Amsterdam and London, dying in the latter place. He never attempted to organize his sympathizers. He was still writing on longitude in 1766 after most of his theological works had been published. He said of himself that he had been led over this pathway from 1710 because 'it was necessary that spiritual things should now be understood rationally; therefore I was first introduced into the natural sciences and thus prepared; the dogma that the understanding is to be held under obedience to faith had closed the Church, and what can open it except an understanding enlightened by the Lord?' He also declared that he had received nothing from any one but the Lord through study of the Scriptures.

Literature: of the biographies of Swedenborg that of BENJAMIN WORCESTER (1883) is the best. His works have been issued in the original Latin, in English, and many other languages. The principal books not mentioned above are *Heavenly Arcana*, *Apocalypse Revealed*, *Heaven and Hell*, *Doctrines of the New Jerusalem*, *Intercourse of Soul and Body*, *Marriage Love*, and *True Christian Religion*. (T.F.W.)

Swoon [ME. *swowen*]: Ger. *Ohnmacht*; Fr. *évanouissement*, *syncope*; Ital. *svenimento*. A faint; loss of consciousness. See SYNCOPE. (J.J.)

Syllogism [Gr. *συλλογισμός*]: Ger. *Syllogismus*, *Schluss*; Fr. *sylogisme*; Ital. *sillogismo*. (1) Syllogism consists in stating in one proposition the truth involved in two non-relative propositions after the elimination of a common term, as

(s) All *a* is *b*;
All *c* is *a*;
∴ All *c* is *b*.

The first of these propositions (which contains the predicate of the conclusion) is called the major premise; the second, which contains the subject of the conclusion, the minor premise. (C.L.F.)

(2) According to Aristotle and the great body of logicians, a simple syllogism has two premises and a conclusion, and three terms, one of which, the 'middle,' disappears from the conclusion. In the writer's opinion, the limitation to non-relative premises is contrary to usage and to propriety. (C.S.P.)

(3) The sense laid down by Aristotle at the opening of his *Analytics*, 24 b 18, and repeated with verbal accuracy at the beginning of the *Topics* and at the beginning of the *Sophistici Elenchi*, and less formally in the logical part of the *Rhetoric* (A ii. § 9), namely, *Συλλογισμός ἐστὶ λόγος ἐν ᾧ τεθέντων τινῶν ἕτερόν τι τῶν κειμένων ἐξ ἀνάγκης συμβαίνει τῷ ταῦτα εἶναι*, 'A syllogism is a symbol (λόγος) in which, some things having been posited, something different from the assumptions necessarily joins itself to them, by being involved in the being of the facts assumed.'

It will be seen that, in this definition (2), no particular stress is placed upon the premises being two in number; although Aristotle is afterwards emphatic in insisting that every syllogism has two premises. The following inference is, on this definition, syllogistic: 'A stands to a lover of B in the relation of benefitting everybody loved by him; hence A benefits B.' The two essential characters are that the inference shall be necessary, and that the fact inferred shall be involved in the very being of the facts premised, regardless of the manner in which those premised facts may have become known. The operation called *colligation* by Whewell, which consists in bringing the different premises together and applying them, the one to another, or to a repetition of itself, in a particular way, wherein lies all that calls for sagacity in deductive reasoning, is then no part of the syllogism. Aristotle seems to say (1 *Anal. Pr.* xxxii) that some necessary inferences are not syllogisms; but the passage is not clear. However, if

colligation is to be excluded from syllogism, then also such an inference as the following will be non-syllogistic: 'Every man is an animal; hence whatever is in a given relation (as for example, 'other than') to every man is in that relation to every animal.'

An argument consisting of a single syllogism is a monosyllogism, one of more than one a polysyllogism, called also *monosyllogistic* and *polysyllogistic proof*.

Trendelenburg, in his *Elementa Logices Aristotelicae*, gives an account of the origin of the word, remarking that *συλλογίζεσθαι* is properly to conjoin in arithmetical computation or in reasoning. Thus, in the *Philebus*, 41 C, where Jowett translates 'you may infer,' the word means to put together two conclusions already reached and then deduce a further result. In the *Theaetetus*, 186 D, where it is said that *ἐπίστήμη* does not consist *ἐν τοῖς παθήμασι*, but *ἐν τῷ περὶ ἐκείνων συλλογισμῷ*, *συλλογισμός* is a synonym for what in the *Phaedrus*, 249 B, is called simply *λογισμός*, "ἐκ πολλῶν ἰὼν αἰσθήσεων εἰς ἓν λογισμῷ ἐνναιρούμενον." And Trendelenburg is of opinion that there are in Aristotle traces of the broader meaning, as when he speaks of *ὁ ἐξ ἐπαγωγῆς συλλογισμός*. Others, however, think that Aristotle's language shows that he drew a distinction between *ἐπαγωγή* and the syllogism from *ἐπαγωγή*, the latter being valid only in case of a complete enumeration. Bonitz, however, gives other instances of Aristotle's using the word in a broad sense. The chief of these is in *Rhetoric*, A xi. § 23, where Cope's note quoting a similar passage in the *Poetics* is interesting. Lutoslawski points out that one of Plato's very earliest dialogues, the *Charmides*, 161 A¹, contains a regular syllogism in *Cesare* introduced by the word *συλλογισμῶν* (160 E). He also remarks that in the *Philebus*, the term *μέσον* is used in the same technical sense as in Aristotle, and adds: 'If we take into consideration that it would be entirely against Plato's view of literary composition to enumerate all possible figures of syllogism in a dialogue, as is done in Aristotle's treatise, it becomes quite possible and even probable that Aristotle's theory of syllogism was more than prepared by Plato.' Of course this can be no more than a surmise, but it is a reasonable

one, since Plato's mathematical mind would naturally have looked at reasoning in a formal light. At any rate it is almost incredible that any man should have struck out all that is in Aristotle's *Analytics* if the ground had not been prepared. Moreover, Aristotle everywhere exhibits a mind quite unmathematical, so that one cannot but suspect that he received some hints towards a general outline of syllogistic from some source. Yet we cannot, for an instant, doubt Aristotle's veracity in the last chapter of the *Sophistici Elenchi*, where he says of syllogistic: 'Of this subject, on the other hand, there has not been a part cultivated and a part neglected, but nothing whatsoever of it has hitherto existed. . . . About syllogizing I am aware of absolutely nothing having been previously said [*περὶ δὲ τοῦ συλλογίζεσθαι παντελῶς οὐδὲν εἶχονεν πρότερον ἄλλο λέγειν*]' (C.S.P.)

[The two sections following are written from the points of view of the two definitions respectively, and reflect current differences of view. — J.M.B.]

(1) Deductive reasoning in general is stating explicitly (in a conclusion) something which has already been implicitly stated either in a single proposition, or in several propositions put together (called the premise, or the premises), thus—

If every point of the line *x* is equidistant from *A* and *B*, and if every point of the line *y* is equidistant from *B* and *C*, it follows that what are points at once of *x* and of *y* are equidistant from *A*, *B*, and *C*.

Drawing a conclusion from a single premise is called 'immediate inference'; the conclusion may be equivalent with the premise (that is, it may furnish sufficient ground for recovering the premise)—in this case a mere transformation of the original premise has been per-

¹ Written, as there is strong unpublished ground for thinking, 394 B.C., while Aristotle only went to Athens 368 or 367 B.C. (Grote thinks not till 362 B.C.) All the other dialogues here mentioned are subsequent to Aristotle's joining the school.

¹ It has been argued that Aristotle may here, as it is said he often does, employ the first person plural to mean the students of Plato; and also that πρότερον ἄλλο would not exclude aid from contemporaries. The present writer, without making any particular pretension to philological learning, apprehends that it is quite clear that Aristotle is speaking of himself personally, and that he means to say that no doctrine of the syllogism, in which he now takes the first steps (ὡς ἐκ τούτων ἐξ ἀρχῆς ὑπαρχόντων εἶναι ἡ μέθοδος), had existed before his *Analytics* and *Topics*. Such hints as he may have received from Plato cannot (the writer believes) have been in Aristotle's memory when he penned those words. But a man does not always know how he originally came by ideas which occupied him at first little, but afterwards more and more, up to almost complete absorption for many long years.

formed; or it may state less than the premise, in which case it may be called an UNDER-STATEMENT (q.v.). If the conclusion is drawn from more than one premise the reasoning is called 'mediate.'

In the example given above, all the terms about which information is given in the premises reappear in the conclusion; but in the most useful form of mediate reasoning, there is involved the dropping of information, and usually of information concerning a term involved in each of the two premises; this may be referred to as the elimination of a middle term. Thus in

A is in the same box with X;
(r) B is in the same box with X;
∴ A and B are in the same box with each other,

the conclusion is irrespective of the middle term X. If what is desired is information about the relation of A and B to each other, then dropping all information concerning X is the removal of what was burdensome—is a loss which is a gain. Eliminative reasoning may be defined to be the throwing away of information (partly contained in each of two premises) concerning uninteresting terms and saying what remains in one proposition. (If the information which is dropped was contained in one of the premises only, it is simply a case of under-statement.) So we come to the definition (1) of the syllogism: if the relation between the terms involved in an instance of eliminative reasoning is the simple copulative connection expressed in *is* or *implies* (in any of their forms—*a is b*, *Some a is not b*, *That a is b implies that c is d*. See PROPOSITION) the reasoning is called 'syllogism.'

The syllogism is frequently defined as a group of three judgments, of which the last is necessitated by the two preceding, but that does not exclude such an argument as (m), which few persons would consider a syllogism. It is also defined (Lotze) as the union of two judgments to produce a valid third judgment (not consisting in the simple summation of the other two); and by this definition the argument (r) is not excluded. More successfully, the syllogism has been defined in general terms to consist in the applying of a general rule to a special case. The general rule, or law, is the major premise, the special case is the minor premise, and the application is the conclusion:

(4) Rule,
Case,
Application.

(The word application, like conclusion and judgment, is unfortunately ambiguous; we should say the applying, the concluding, the judging, for the act, and leave the other words for the product of the act. The term RESULT (q.v.) has also been used.) This definition, of course applies, like the *dictum de omni*, only to the first figure.

It has been argued by many logicians that all reasoning is syllogistic, and by many others that not all reasoning is syllogistic. The solution to the difficulty is this: both contentions are legitimate, but the different parties to the discussion take a different view as to what constitutes the reasoning in a given argument. Thus the argument (r) can be put in the form: If two things are in the same box with a third thing, they are in the same box with each other; but A and B are in the same box with X, and hence, &c., and this, it is said, is surely syllogism. The question, now, is this: Did the reasoning in (r), as first given, consist in the referring, implicitly, to some authorizing principle, or is it characterized by the nature of the authorizing principle referred to? On performing an ordinary syllogism, we have in mind the *dictum de omni* as our legitimizing principle, and in referring to it (instinctively) we are again going through an instance of rule-case-application. Now which constitutes this syllogism—the referring, or the principle referred to? It seems most natural to say the latter, and to conclude, therefore, that the argument (r) is not a syllogism, but an argument corresponding to it, for which the legitimizing principle is a *dictum* concerning the copulative relation 'is in the same box with,' and corresponding in form, in this case, with the *dictum* of Aristotle. There are countless relations of this sort which are transitive (or, as it might better be called, eliminative), and of which the 'principle' is perfectly self-evident to us. There are others, of course, which offer no ground for the elimination of a common term; as, A is longer than X and B is longer than X. Bradley is severe upon that large body of logicians who maintain that all mediate deductive reasoning is syllogistic. [It would seem to be a matter of definition, of the use of a term; there seems to be a large majority in the 'large body,' and the psychology of reasoning appears to lend support to their view.—J.M.B., C.S.P.]

It has been sometimes said that the validity of the syllogism can be made to depend upon the laws of thought, but the assertion that the

syllogistic axiom can be derived from anything else whatever is a contradiction in terms—it can be proved that the syllogism cannot be proved. For proof consists in referring a special case to a general rule, under which it is shown to fall, and that very act has its justification only in the principle of the syllogism. What principles shall be assumed as the fundamental axioms of any branch of knowledge is, to a certain extent, a matter of convenience—frequently, of two, each will entail the other, and it is sufficient to assume either one. But this does not apply to the syllogism; whatever else may be regarded or not regarded as an indispensable assumption, the axiom of the syllogism must always be assumed the first thing of all, for without it nothing can be derived from anything. Various forms of expression in words have been given to this axiom, as the *dictum de omni*—Whatever can be affirmed of the whole can be affirmed of what has been shown to be a part of the whole (as usually given, this applies only to immediate inference, not to the syllogism); or, in terms of pure intention, the *nota notae*—A mark of a mark is a mark of the thing itself. For the syllogism in the second and third figures (with the middle term as predicate, or as subject, of both premises) other principles are needed (Lambert), or those figures can by processes of REDUCTION (q.v.) be brought to the first figure. Wundt gives, as covering mediate inference in general (r), what he calls 'the principle of relation,' which amounts to this—Things which stand in a relation to a third thing stand in a relation to each other. But this is simply incorrect; if A and B are each X, they need not stand in any direct relation whatever to each other; if A is longer than X and B is longer than X, nothing whatever can be affirmed about the relation of A to B. Relations are too various to permit of any general statement being made about them—some are mediating and some are not.

There is still another view of the principle of the syllogism, which has been held by various writers. It is that it is sufficiently contained in the definition of the proposition—that in saying *Whatever is a is b*, it has already been said that anything that can be shown to be a is b. Thus the doctrine of the syllogism, under the aspect of rules applied to cases, becomes a tautology; it is simply—A general rule can be applied to any special case that can be shown to fall under it. Mill's

objection to the syllogism would here amount to saying that there can be no fresh application of a general rule to special cases; for until after you have tested it in all its special cases, you are wrong to believe that the rule is really general.

From the time of Sextus Empiricus, it has been maintained by different writers that the syllogism is of little value, that is, leads to no advance in thought, because the conclusion is already contained in the premises. It is true in a sense that there is no gain in material knowledge in the syllogism, but the gain through convenience of manipulation is great. Thus if the axioms, postulates, and definitions of geometry, accurately and fully stated, were handed over to a master of symbolic logic, he could deduce from them, with infallible certainty, the latest proposition of Euclid without stopping to state any of the intermediate propositions; but ordinary reasoners find it vastly more convenient to proceed from step to step, and in fact ordinary human powers, unaided by a mechanical device, do not suffice for any different procedure. What the formal reasoner as such actually does is to sit at his desk, and taking into his consciousness statements of fact brought to him from South Africa and China, from the metaphysical assumptions of the speculative philosopher and from the laboratory work of the experimental psychologist, to piece them together, so far as they have anything in common, and to get out of them things not known before they fell together. His intellectual work consists (1) in the search for middle terms, and (2) in the reduction of the propositions containing them to forms in which he is capable of seeing what relations implicitly contained in them he can make explicit, and (3) in stating those conclusions in single sentences. For example, the syllogism

No priests are martyrs;
(v) All but priests are saints;
∴ All martyrs are saints,

cannot be seen intuitively by every one to be either valid or invalid. (To get the real force of the syllogistic formula, it is much better to practise on propositions which are not true.)

Another objection that has been brought against the syllogism is that the conclusion is not contained in the premises, that until the conclusion has been separately tested, it is not safe to say that the major premise is universally true. Bain has very justly said that the contribution made to logic by Mill in connec-

tion with this question is revolutionary; it is, however, properly speaking, a contribution to the theory of knowledge rather than to the theory of the syllogism in itself. His thesis is not so much that 'real reasoning is from particulars to particulars,' as it is that 'all knowledge is in the last resort empirical.' Aristotle himself, according to H. Maier (*Die Syllogistik des Aristoteles*, 1900), was not ready to admit the validity of the syllogistic form as such, in those cases in which the premises are insecure. Our vast structure of knowledge is composed of elements of various degrees of certainty. One piece or another, from time to time, suffers shipwreck; but many pieces have had their validity so thoroughly tested that *relatively* they are inexpugnable. The objection is perfectly well founded in instances where the general rule is got as a direct abstraction from the special cases, and also in the cases where, for any other reason, our grounds for believing it are relatively uncertain; but under all such circumstances we are perfectly aware of what is the real value of the syllogism—that it is in such cases this very function (the testing of the major premise) for the sake of which we perform it. The progress of science consists in great part in guessing at general rules, or in accepting them temporarily as furnished us by more or less uncertain inductions, in applying them to special cases, and then in returning to nature to see if the result of the application holds good. If it does, the rule is in so far confirmed; if it does not, the rule must be revised—for the moment it has become a humble particular, which we hope to elevate again into the rank of a universal by finding some appropriate determinant of the subject, or alternation to the predicate, to connect with it. Thus if $a \leq b$ is found to have exceptions, our next step is to discover the x or the y which will give us $ax \leq b$ or $a \leq b + y$. If, on the other hand, there is a general rule in which we have confidence, and observation has just furnished us with a special case, if the application of rule to case gives a result out of harmony with well-known facts, it is the accuracy of our observation of the special case that we proceed to improve upon. There are always some propositions which are so vastly superior to others in respect of certainty that, unless we are to renounce the task of living altogether, we must feel ourselves authorized to take them as safe premises.

The Modern Treatment of the Syllogism.

Modern logic, which begins with De Morgan and Boole, has for one of its principal characteristics the unrestricted admission of negative terms; the older logicians were chary of introducing them as predicates even. They regarded such a proposition as *Some a is not b* as belonging to a separate category from the universal and the particular proposition, and gave it a distinctive name—the 'infinite or limitative proposition.' But this is unnecessary; it is perfectly safe to treat negative terms like any other terms. And it is only this aversion to dealing with negatives that has caused the logicians to consider that

- (n) $\begin{aligned} &\text{No } a \text{ is } b; \\ &\text{No } c \text{ is } \bar{b}; \\ &\therefore \text{No } a \text{ is } c, \end{aligned}$

is not a syllogism at all. The infelicity of this has been pointed out, among others, by Bradley. It is not a syllogism in the restricted traditional sense of the word, but it is an argument so exactly like it that the difference is entirely inessential; it is merely necessary to let 'common term' include 'common term though of different quality,' for the common definition of syllogism to cover cases like this. The ordinary rules for the validity of syllogistic reasoning are applicable only if the propositions are stated in some one of the four traditional forms. When the eight propositions of the Complete Scheme are taken account of, the restrictions as to negatives being done away with (see PROPOSITION), the number of fruitful pairs of premises is vastly increased. The argument, e. g.,

- (p) $\begin{aligned} &\text{Everything is either } a \text{ or } c; \\ &\text{Everything is either } b \text{ or } \bar{c}; \\ &\therefore \text{Everything is either } a \text{ or } b, \end{aligned}$

would seem strange to the strict Aristotelian, but with the enlarged meaning of common term it falls strictly within the definition of syllogism. And as frequently happens in such a case, the whole is found to be, as regards difficulty, much less than the part; rules for validity, as will appear immediately, are far more simple than with the ordinary propositional scheme.

Two premises and a conclusion taken together constitute a syllogism; the three following propositions taken together—

- 'None who are discontented are happy,'
'But some reformers are happy,'
and no reformers are contented,'

form an argument,—not, it is true, an argument in which there is a sequence, but an argument in which there is a rebuttal. (It is, without doubt, the form in which, in primitive

times, argument first arose; propositions are accepted 'unthinkingly' until after they have been uttered, and have aroused—the regular effect of listening to speech—the instinct of rejection on the part of the hearer.) In this argument the implication contained in the word *but* is that the statements made cannot be all three true together; if the last two are true, the first is not so; if the first and either of the others are true, the remaining one is not true. In other words, the three propositions taken together constitute an inconsistency, or an incompatibility, or, as it may perhaps be called, to distinguish it from the syllogism, an antilogism. Expressed in letters for terms, it affirms that no a is b , no c is non- b , and some a is c cannot be all three true at once; if any two of them are known to be true (it matters not which two) the remaining one is known to be false—that is as much as to say that its contradictory is known to be true, and to be, therefore, the conclusion of a valid syllogism of which the other two are the premises.

If we write for the moment (ab) , for *No a is b* and (ac) for *Some a is c* (u is chosen as standing for a part of the universe), we may put this:—

$$(ab), (\bar{c}b), (ac), \leq 0,$$

which is read *That no a is b , no c is non- b , and some a is c is impossible.* The simple test for the validity of this form of argument is this: (1) *There are three propositions, two universal and one particular, each two with one term in common.* (2) *The term common to two like propositions must appear with unlike signs; the term common to two unlike propositions must appear with like signs.* The dictum involved is simply the principle of Excluded Middle: ac is not b (for no a is b), and it is not non- b (for no c is non- b), and hence it cannot exist at all.

The simple device, therefore, for testing the validity of any of the thousands of syllogisms such as (v) and (p), which may present themselves to the actual reasoner, in addition to the ordinary syllogisms of the logics ($16 \times 16 \times 16 \times 2$, or 8,192 in all), is to turn every universal proposition into the form *No a is b*, every particular into the form *Some a is b*, to deny the conclusion, and then to apply the rule just given. The source of the simplicity of this rule is that symmetrical copulas are used throughout, and that therefore it no longer makes any difference whether a term stands in the subject or in the predicate.

A consideration of these more general forms covers, in simple terms to start with, all the

so-called hypothetical and alternative syllogisms, and many more, of course, than are usually treated in the textbooks. The existential syllogism is represented, in terms, by

- $\begin{aligned} &\text{All } a \text{ is } b; \\ &a \text{ is existent}; \\ &\therefore b \text{ is existent}, \end{aligned}$

which is the exact parallel to

- $\begin{aligned} &\text{Always, if } a \text{ is } b, c \text{ is } d; \\ &\text{That } a \text{ is } b \text{ occurs (here and now);} \\ &\therefore \text{That } c \text{ is } d \text{ occurs (here and now).} \end{aligned}$

These last two forms differ from the ordinary syllogism merely in the fact that one of the SPECIAL TERMS of logic (q. v.) occurs as a predicate. They may be named *existential syllogisms*. Modal propositions are most simply treated by making the modal word a predicate, instead of attaching it to the copula—that is, by transforming *a is possibly b* to *That a is b is possible*. We have merely to remember, then, that the negative of *necessary* is *possibly not*, and that the negative of *possible* is *necessarily not*. (C.L.F.)

(2) The syllogistic inference may be analysed into several distinct steps, each of which shall consist either in inserting or in omitting something. It does not evidently follow that such a method must afford a simpler representation of necessary inference than to take the inference of the *modus ponens* as elementary. But in point of fact it does so. The passage from premise to conclusion may be regarded as a permissible transformation, and best, of a transformation of the nature of an insertion; that is to say, the conclusion is superadded to the premises; since the premises remain true.

Aristotle's verb *συμβαίνει* in the definition of the syllogism takes this view. The relation between the protasis and apodosis of a hypothetical proposition differs formally from the relation between a premise and conclusion in no essential respect except that the protasis is not positively asserted. To regard the fact C as necessarily following from the facts A is to hold that whenever facts analogous to A are true, a conclusion related to them as C is to A will always be true. In the proposition, 'If A is true, C is true,' we may have regard only to the actual state of things; in any case the proposition is equivalent to 'Either A is not true, or C is true.' But more usually we refer to a range of possibilities, and mean that whenever any fact analogous to A is true, that which is related to it as C is to A is true. The same relation subsists between the subject and

predicate of a universal proposition: to say that 'All men are mortal' is to say that, taking any object X whatsoever, if X is a man, X is mortal. This agrees with the definition of universal predication given by Aristotle, and commonly known as the *dictum de omni*. It will be remarked that this definition does not make a universal proposition to assert the existence of its subject.

Now, since in any possible system of logical representation illative transformation must be performed and be recognized as permissible, it follows that any representation of a universal proposition which treats any other relation than that of the conclusion (with the premises) to the premises alone as the principal relation expressed by the proposition, leaves the logical analysis incomplete.

Three figures (see FIGURE, syllogistic) of syllogism were recognized by Aristotle, in the first of which the middle is subject of one premise (the *major* premise) and predicate of the other (the *minor* premise); in the second the middle is the predicate of both premises; while in the third the middle is subject of both premises. Aristotle recognizes but four moods (see MOOD, in logic) of syllogism in the first figure. Some early Peripatetic, Theophrastus it is said, added five indirect moods: *Baralipon*, *Celantes*, *Dabitis*, *Fapesmo*, *Frisosomorum*. It is rumoured that Galen first constituted a fourth figure by transposing the premises of these. About the 16th century this figure began to be commonly admitted, and is now almost universally so. With this, the five moods have somewhat unnecessarily changed their names. Those now most usual are *Bramantip*, *Camenes*, *Dimaris*, *Fesapo*, *Fresison*.

The logic of RELATIVES (q.v.; see also SYMBOLIC LOGIC) throws great light on syllogism. It shows that the copulated premises are, as expressed in Reirce's algebra of dual relatives, in one of the three forms,

$$(x+y)(y+z) \quad (x+y)yz \quad (xy)yz$$

These give respectively

$$x+z \quad xz \quad xTz$$

The last is a so-called spurious conclusion, but such syllogisms are unscientifically excluded from consideration in almost all treatises. There remain, therefore, but two kinds of syllogism, the *universal* and the *particular*. Beginning with *Barbara*, it can be mathematically proved that every possible necessary inference from two premises, both having the same form as the conclusion, must depend upon a relation of *inclusion* (see Schröder, *Alg. u.*

Log. d. Relative, 337 ff., where the 'solution' given of transitivity is the most accurate possible definition of *inclusion*, in that general sense in which a thing need not necessarily include itself). Thus,

The S 's are included among the M 's;

The M 's are included among the P 's;

\therefore The S 's are included among the P 's.

So, for example, the pseudo-syllogism $S < M$, $M < P$, $\therefore S < P$, depends partly on the fact that $S < P$ implies that the units required to measure S are included among those required to measure P , and partly on the fact that $S < P$ implies that the units required to measure P are not included among those required to measure S . Putting, therefore, s, p , and m for the units required to measure S, P , and M , we have, on the one hand,

The s 's are included among the m 's;

The m 's are included among the p 's;

\therefore The s 's are included among the p 's;

and, on the other hand,

The s 's are included among the m 's;

The p 's are not included among the m 's;

\therefore The p 's are not included among the s 's.

If, in order to study the differences between the different moods of syllogism, we suppose that in the universal proposition S and P are modified by relatives, these must be the same for both, in order that *Barbara* should be valid. Calling this common relative h , the form of the universal affirmative, A , can only be one of the two following:

Any h of an s is an h of a p ;

Any h of every s is an h of every p .

These differ merely as being the converse of one another. For putting k for non- h , the latter is equivalent to

Any k of a p is a k of an s .

We may, therefore, assume the first of the two forms as the form of A . Then the validity of *Celarent* requires only that the universal negative E shall have for its subject, 'Any h of an s ' or 'Something not an h of an s '. The validity of *Darii* requires only that the predicate of the particular affirmative, I , shall be 'is an h of a p '. The validity of *Ferio* requires that the subject of the particular negative, O , should agree with that of I (in a sense not easy to explain without special notation), while its predicate should be the same as that of E , and further, that if either I or E expresses existence, so should O . The validity of *Baroko* and the moods of the second figure, generally, requires that the predicate of O (and of E) should be 'is not an h of a p '. The validity of *Bokardo* requires that the subject of O (and

of I) should be either 'Some h of an s ' or else 'Anything but an h of an s '. The result is that there are three systems of propositions which give all the traditional moods, except *Darapti*, *Felapton*, *Baralipon*, and *Fapesmo*, which are invalid if universal propositions are understood to be the exact denials of particular propositions. These three systems are:—

FIRST SYSTEM.

- A. Any h of an S is an h of a P ;
- E. Any h of an S is not an h of a P ;
- I. Some h of an S is an h of a P ;
- O. Some h of an S is not an h of a P .

SECOND SYSTEM.

- A. Any h of an S is an h of a P ;
- E. Something not an h of an S is not an h of a P ;
- I. Whatever is not an h of an S is an h of a P ;
- O. Some h of an S is not an h of a P .

THIRD SYSTEM.

- A. Any h of an S is an h of a P ;
- E. Any h of an S is not an h of a P ;
- I. Whatever is not an h of an S is an h of a P ;
- O. Whatever is not an h of an S is not an h of a P .

The O of the third system might have been taken as A , and the same forms would have been reproduced in the same way with changed h . In the ordinary syllogistic the first system is used, and h is 'identical with.' With a limited universe of marks, h will be a 'character of.'

It will be observed that *Celarent* and *Darii* introduce each an additional principle in slight modification of *Barbara*, and *Ferio* reunites those principles. The *second* and *third* figures introduce marked additional principles, which the so-called fourth figure, i.e. the Theophrastean syllogism, reunites. In the second figure there is a perceptible difference between the mode of inference of *Camestres* and *Baroko* on the one hand, *Cesare* and *Festino* on the other; although in reasoning itself it is morally impossible to distinguish *Camestres* from *Cesare*. Parallel remarks apply to the third figure. Of the Theophrastean moods, *Frisosomorum* alone is peculiar, *Celantes* and *Dabitis* depending merely on the principles of the second and third figures respectively.

The fact that the second and third figures involve peculiar principles is shown by the fact that the modes of reduction of any mood of each involve some peculiar immediate inference.

Thus, the reduction of the second figure involves the conversion of E . Now this conversion can be stated in syllogistic form; but it will be a syllogism in *Cesare*, which is the typical mood of the second figure, thus:—

No M is N ;

Any N is N ;

\therefore No N is M .

So the third figure involves the conversion of I , and when this is put into syllogistic form, the syllogism is in *Dabitis*, the typical mood of the third figure, thus:—

Any N is N ;

Some N is M ;

\therefore Some M is N .

It may be said that the convertibility of I depends upon the equiparance of the relation which I expresses. But even in that case, it must be noted that there is a certain difference between the *individual* and *definite* convertibility commonly understood by equiparance and the *indefinite* conversion, properly understood, of I , which is alone required in ordinary syllogistic. This will appear below.

The second and third figures can be reduced to the first apagogically, but the principles of the reduction are different. That of the second figure is that if the *negative* (not the denial) of the result of a hypothetical assumption under a known rule is found to be true, then the negative of the subsumption is true. Thus, referring to the usual syllogism, 'All men are mortal; all patriarchs are men; hence, all patriarchs are mortal'; if the rule is correct, get all patriarchs are immortal, it follows that all patriarchs are non-men. The statement of this principle is simply a form of the conversion of E . So the third figure may be apagogically reduced by the principle that if, a subsumption under a hypothetical rule being admitted, a partial result is found true, the partial truth of the rule follows. Thus, admitting that all patriarchs are men, if it be found that some patriarchs are mortal, it follows that at least some men are mortal. The second figure can always be reduced to the first by the simple conversion of the major premise, this being first made negative, if necessary, by infinitation. Thus,

Any M is P = Any M is not not- P ;

Any } S is not P ;

Some } S is not P ;

Any } S is not M ,

Some } S is not M ,

is reduced by the conversion of the major to

'No not- P is M .' So the third figure is reduced to the first by the simple conversion of the minor premise. But there is here a difficulty, owing to our not having in our ordinary languages a term to express the reversal of the quantity of a proposition; that is to say, a single operation which shall change Any to Some, and Some to Any.

The difference between a particular and a universal proposition is that, in the former, the selection of the individual of which the predicate is asserted is transferred from the hearer to a person competent and friendly to the proposition. Let this transfer be repeated, and the choice goes back to the first party. Using 'some' in the sense of prescribing such transfer, 'Some-some- S is P ' = Any S is P . In that way *Disamis* and *Bokardo* are reduced as follows. The moods are:

Some S $\left\{ \begin{array}{l} \text{is} \\ \text{is not} \end{array} \right\} P$;
Any S is M = Some-some- S is M ;
 \therefore Some M $\left\{ \begin{array}{l} \text{is} \\ \text{is not} \end{array} \right\} P$.

Converting 'Some-some- S is M ' to 'Some M is Some- S ,' we have the syllogism of the first figure—

Any Some- S $\left\{ \begin{array}{l} \text{is} \\ \text{is not} \end{array} \right\} P$;
Some M is Some- S ;
 \therefore Some M $\left\{ \begin{array}{l} \text{is} \\ \text{is not} \end{array} \right\} P$.

Any syllogism of the second or third figure can also be reduced by transposing the premises, and converting the two propositions not converted in the method just described. But still the same kind of conversion continues to be required in the case of each figure, thus showing that the conversions of E and I are logically allied to the second and third figures respectively. *Camestres* and *Disamis* are the easiest so to reduce; *Festino* and *Perison* the most difficult.

Festino.

Some S is P = No Some- S is not- P ;
No M is P = Any M is not- P ;
 \therefore Some S is not M = No Some- S is M .

The conversion of E gives from the first premise 'No not- P is Some- S .' This with the second premise gives 'No M is Some- S .' Thence another conversion of E gives 'No Some- S is M ,' which is the conclusion.

Perison.

Some S is M = Any Some- S is M ;
No S is P = Some-some- S is not- P ;
 \therefore Some M is not P = Some M is not- P .

The conversion of I gives from the second premise 'Some not- P is Some- S .' This with the first premise gives 'Some not- P is M ,' which by another conversion of I gives 'Some M is not- P ,' the conclusion.

The conversion of E depends on the fact that otherness is an equiparance. If everybody loves everybody who loves him, it follows that if every man loves every woman, then every woman loves every man; and on the corresponding principle, if every S is other than every P , then every P is other than every S . The conversion of I, on the other hand, is justified by the fact that the propositional quantities of breadth and depth are inseparable. 'Some S is P ' = There is an embodiment of S conforming to the idea of P .

Now observe that we do not necessarily infer that that same P is S , but only that there is somewhere a P that is S . All that is needed for this inference is that whenever there is an embodiment of an idea conforming to a second idea, there is also an embodiment of the latter idea conforming to the idea first embodied. It is the principle that there cannot be a cork that fits a bottle unless there be a bottle that is fitted by a cork.

When we pass to probability the figures of syllogism become of an idea highly important. Thus, take the following reasoning, the nature of which we shall presently examine:

The probability of throwing doublets with a pair of dice is $\frac{1}{6}$;
Different throws of pairs of dice are independent;

\therefore The probability of throwing precisely two doublets in six throws is just half that of throwing precisely one doublet in six throws.

In order to analyse this reasoning, it is necessary to note what the premises and conclusion mean. The precise meaning of the first premise is that we should square our actions on each single occasion to the fact that, taking throws of the dice as they occur in the course of experience, the ratio of the number of throws of doublets hitherto to the total number of throws hitherto would, if the course of experience were endless, become, after a time, permanently remote from every other ratio than 1:6, but would never become so from this ratio. The meaning of the second premise is that this is so not only for all the throws, but also for every endless portion of that totality of throws whose selection is determined by the ordinal relation of the throws composing it to previous throws of any given

kind; so that, where such principle of selection allows, the throws are taken as they occur in the course of experience in endless succession.

The necessary conclusion is that we should square our action on any occasion to the principle that taking an endless succession and entirely different sets of six throws, just as they occur in the course of experience, the ratio of the number of sets containing two doublets to the number of sets containing one doublet will at length permanently depart from every other ratio than 1:2, but will not so depart from this ratio.

This inference is necessary; yet it is merely probable in this sense, that we cannot be sure that the number of sets of six throws containing just one doublet would be twice the number containing two doublets in a hundred trials, or in a million, or in any other fixed number. But what is certain is that any other ratio would eventually prove decidedly wrong, while 1:2 would not. This is a probable syllogism of the first figure, since it recognizes a case as coming under a general rule, the result of which it accepts as valid in that case. Of course the reader will not fail to observe that the sense in which the reasoning is said to be a syllogism is strictly defined. It is not meant that the above is a simple syllogism.

But if it were not known exactly how often with a given set of dice doublets would be thrown, since they may be similarly or dissimilarly loaded, and if we simply threw the dice and counted the whole number of throws and the number of throws of doublets, and if, finding that in twelve hundred throws there were about two hundred doublets, we were thence to conclude that in the long run about one-sixth of the throws would be doublets, this would be reasoning in the third figure. This would be in no sense necessary, except that if the experimentation were continued endlessly, it must approximate to the true ratio at last. This form of reasoning differs from the probable syllogism of the first figure, in that there the precise value of the long-run ratio was stated in advance; while here the concluded ratio is subject to modification as experience is amplified.

It is inference in the third figure, since if the rule were that any ratio far from one-sixth would be satisfactory in the long run, the same ratio would probably be tolerably satisfactory in twelve hundred throws. Now, no ratio far from one-sixth is satisfactory for

this set of twelve hundred throws. Hence, the rule is probably false. Now, the inference that a general rule is false because the result to which it would lead in a special case is not true is syllogism of the third figure. Although this mode of inference is not necessary, it is necessary that the method should ultimately yield an approximately correct conclusion.

A probable syllogism which appears, in consequence of a want of sharp insistence upon what is really the subject and what the predicate of propositions, to be in the second figure may be essentially of the same nature as a probable syllogism in the third figure; but it seems to be impossible that it should really be so, since there can be no strict objective probabilities of the kind required. If, for instance, we knew that in a considerable series of sets of six throws, one doublet precisely had occurred in a set twice as often as two doublets precisely, and we were thence to conclude that the two dice were probably normal, because, although other constitutions of dice might produce the same result, yet they are very unusual constitutions, we have here a probability of quite another kind; and instead of its being certain, as in the third figure, that the method of inference would in the long run lead to an indefinite approximation to the truth, it is here quite possible that the concluded constitution of the dice will always be entirely different from the true one. The three figures are therefore quite distinct; and we see that probability lends an importance to the three figures which modern logicians have not been willing to accord to them.

Aristotle pays no attention to hypothetical syllogisms; but it is said that Theophrastus studied them. We find them treated in considerable detail by Boethius. During the middle ages, purely formal syllogistic made no progress worth mention. About the middle of the 19th century some steps were taken. Sir W. Hamilton proposed a syllogistic system of no merit (see *An Essay on the new Analytic of Logical Forms*, by T. S. Baynes, Edinburgh, 1850) based on the following system of propositional forms, called the system of the thoroughgoing quantification of the predicate.

All A is all B , meaning that the whole collection of A 's is identical with the whole collection of B 's.

All A is some B , meaning that the whole collection of A 's is identical with part of the collection of B 's.

