A

SYLLABUS

OF CERTAIN TOPICS OF

LOGIC

BY

C. S. PEIRCE.

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PREFACE.

This syllabus has for its object to supplement a course of eight lectures to be delivered at the Lowell Institute, by some statements for which there will not be time in the lectures, and by some others not easily carried away from one hearing. It is intended to be a help to those who wish seriously to study the subject, and to show others what the style of thought is that is required in such study. Like the lectures themselves, this syllabus is intended chiefly to convey results that have never appeared in print; and much is omitted because it can be found elsewhere.

MILFORD, PA., 1903, NOV. 1.

AN OUTLINE CLASSIFICATION OF THE SCIENCES.

This classification, which aims to base itself on the principal affinities of the objects classified, is concerned not with all possible sciences, nor with so many branches of knowledge, but with sciences in their present condition, as so many businesses of groups of living men. It borrows its idea from Comte's classification; namely, the idea that one science depends upon another for fundamental principles, but does not furnish such principles to that other. It turns out that in most cases the divisions are trichotomic; the First of the three members relating to universal elements or laws, the Second arranging classes of forms and seeking to bring them under universal laws, the Third going into the utmost detail, describing individual phenomena and endeavoring to explain them. But not all the divisions are of this character.

The classification has been carried into great detail; but only its broader divisions are here given.

All science is either, A, *Science of Discovery*; B, *Science of Review*; or C, *Practical Science*.

By "science of review" is meant the business of those who occupy themselves with arranging the results of discovery, beginning with digests, and going on to endeavor to form a philosophy of science. Such is the nature of Humboldt's *Cosmos*, of Comte's *Philosophie positive*, and of Spencer's *Synthetic Philosophy*. The classification of the Sciences belongs to this department.

Science of Discovery is either, I, *Mathematics*; II, *Philosophy*; or III, *Idioscopy*.

Mathematics studies what is and what is not logically possible, without making itself responsible for its actual existence. Philosophy is *positive science*, in the sense of discovering what really is true; but it limits itself to so much of truth as can be inferred from common experience. Idioscopy embraces all the special sciences, which are principally occupied with the accumulation of new facts.

Mathematics may be divided into **a**, the *Mathematics of Logic*; **b**, the *Mathematics of Discrete Series*; **c**, the *Mathematics of Continua and Pseudo-continua*.

I shall not carry this division further. Branch **b** has recourse to branch **a**, and branch **c** to branch **b**.

Philosophy is divided into, a, *Phenomenology;* b, *Normative Science;* c, *Metaphysics.*

Phenomenology ascertains and studies the kinds of elements universally present in the phenomenon; meaning by the *phenomenon*, whatever is present at any time to the mind in any way. Normative science distinguishes what ought to be from what ought not to be, and makes many other divisions and arrangements subservient to its primary dualistic distinction. Metaphysics seeks to give an account of the universe of mind and matter. Normative science rests largely on phenomenology and on mathematics; metaphysics on phenomenology and on normative science.

Idioscopy has two wings: α, the Physical Sciences; and β, the *Psychical*, or Human Sciences.

Psychical science borrows principles continually from the physical sciences; the latter very little from the former.

The Physical Sciences are, a, *Nomological*, or General, Physics; b, *Classificatory Physics;* c, *Descriptive Physics.*

Nomological Physics discovers the ubiquitous phenomena of the physical universe, formulates their laws, and measures their constants. It draws upon Metaphysics and upon Mathematics for principles. Classificatory physics describes and classifies physical forms and seeks to explain them by the laws discovered by Nomological Physics with which it ultimately tends to coalesce. Descriptive Physics describes individual objects, — the Earth and the Heavens, — endeavors to explain their phenomena by the principles of Nomological and Classificatory Physics, and tends ultimately itself to become classificatory.

The Psychical Sciences are, a, *Nomological Psychics*, or Psychology; b, *Classificatory Psychics*, or Ethnology; c, *Descriptive Psychics*, or History.

Nomological Psychics discovers the general elements and laws of Mental Phenomena. It is greatly influenced by Phenomenology, by Logic, by Metaphysics, and by Biology (a branch of classificatory physics). Classificatory Psychics classifies products of mind and endeavors to explain them on psychological principles. At present it is far too much in its infancy (except linguistics, to which reference will be made below) to approach very closely to psychology. It borrows from psychology and from physics. Descriptive Psychics endeavors in the first place to describe individual manifestations of mind, whether they be permanent works or actions; and to that task it joins that of endeavoring to explain them on the principles of

psychology and ethnology. It borrows from geography (a branch of descriptive physics), from astronomy (another branch) and from other branches of physical and psychical science.

I now consider the subdivisions of these sciences, so far as they are so widely separated as quite to sunder the groups of investigators who to-day study them.

Phenomenology is, at present, a single study.

Normative science has three widely separated divisions: i, *Esthetics;* ii, *Ethics;* iii, *Logic.*

Esthetics is the science of ideals, or of that which is objectively admirable without any ulterior reason. I am not well acquainted with this science; but it ought to repose on phenomenology. Ethics, or the Science of Right and Wrong, must appeal to Esthetics for aid in determining the *summum bonum*. It is the theory of self-controlled, or deliberate, conduct. Logic is the theory of self-controlled, or deliberate, thought; and as such, must appeal to ethics for its principles. It also depends upon Phenomenology and upon Mathematics. All thought being performed by means of signs, logic may be regarded as the science of the general laws of signs. It has three branches: 1, *Speculative Grammar*, or the general theory of the nature and meanings of signs, whether they be icons, indices, or symbols; 2, *Critic* which classifies arguments and determines the validity and degree of force of each kind; 3, *Methodeutic*, which studies the methods that ought to be pursued in the investigation, in the exposition, and in the application of truth. Each division depends on that which precedes it.

Metaphysics may be divided into, i, *General Metaphysics*, or Ontology; ii, *Psychical*, or Religious, *Metaphysics*, concerned chiefly with the questions of 1, God, 2, Freedom, 3, Immortality; and iii, *Physical Metaphysics*, which discusses the real nature of Time, Space, Laws of Nature, Matter, etc. The second and third branches appear at present to look upon one another with supreme contempt.

Nomological Physics is divided into, i, *Molar Physics*, Dynamics and Gravitation; ii, *Molecular Physics*, Elaterics and Thermo-Dynamics; iii, *Etherial Physics*, Optics and Electrics. Each division has two subdivisions. The dependence of the divisions is well marked.

Classificatory Physics seems, at present, as a matter of fact, to be divided, quite irrationally and most unequally, into i, *Crystallography;* ii, *Chemistry;* iii, *Biology.*

But crystallography is rather an offshoot from chemistry, to which it furnishes a few facts, but hardly a principle. It is highly mathematical and depends also on elaterics. Biology might be regarded (although, as a matter of fact, no such view is taken) as the chemistry of the albunoids and of the forms they assume. It is probable that all the differences of races, individuals, and tissues are chemical, at bottom. At any rate, the possible varieties of albuminoids are amply sufficient to account for all the diversity of organic forms.

Pure chemistry seems, ~~at present, to consist of, 1, Physical Chem~~istry, consisting of the old chemical physics and the modern chemical dynamics; 2, Organic Chemistry, Aliphatic and Aromatic; 3, Inorganic Chemistry, consisting of the doctrine of the elements, their atomic weights, periodicity, etc., and the doctrine of compounds.

Biology is divided into, 1, Physiology, and, 2, Anatomy. Physiology is closely allied to chemistry and physics. Anatomy is divided into many distinct fields, according to the nature of the forms studied.

Descriptive Physics is divided into, i, *Geognosy*, and, ii, *Astronomy*. Both have various well-known subdivisions.

Psychology is most naturally divided, according to the methods it follows, into, i, *Introspectional Psychology*; ii, *Experimental Psychology*; iii, *Physiological Psychology*; iv, *Child Psychology*.

This division only admits those parts of psychology which investigate the general phenomena of mind. Special psychology belongs to classificatory psychics. Both Experimental and Physiological Psychology are dependent upon Introspective Psychology. But it is hard to say which of them derives most from the other. Child psychology depends on all the others. Psychology is too young a science to have any further living divisions than such as are here admitted.

Classificatory Psychics is divided into, i, Special Psychology, itself consisting of, 1, *Individual Psychology*; 2, *Psychical Heredity*; 3, *Abnormal Psychology*; 4, *Mob Psychology*; 5, *Race Psychology*; 6, *Animal Psychology*; ii, *Linguistics*, a vast science, divided according to the families of speech, and cross-divided into, 1, *Word Linguistics*; 2, *Grammar*; and there should be a comparative science of forms of composition; iii, *Ethnology*, divided into, 1, the *Ethnology of Social Developments*, customs, laws, religion, and traditions; and, 2, the *Ethnology of Technology*.

Descriptive Psychics is divided into, i, *History* proper, itself

divided according to the nature of its data into, 1, *Monumental History*, 2, *Ancient History with all other History that is drawn from few and general testimonies*, 3, *History drawn from a Wealth of Documents*, as Modern History, generally. History has, beside, two cross divisions; the one into, 1, *Political History*, 2, *History of the Different Sciences*, 3, *History of Social Developments*, Religion, Law, Slavery, Manners, etc.; the other according to the different parts of the world and the different peoples whose history is studied; ii, *Biography*, which at present is rather a mass of lies than a science; iii, *Criticism*, the study of individual works of mind, itself divided into, 1, *Literary Criticism*, 2, *Art Criticism*, of which the latter is divided into many departments, as Criticism of Military Operations, Criticism of Architecture, etc.

The classification of Practical Sciences has been elaborated by the author, but will not here be touched upon. No classification of the Science of Review has been attempted.

THE ETHICS OF TERMINOLOGY.

In order that my use of terms, notations, etc., may be understood, I explain that my conscience imposes upon me the following rules. Were I to make the smallest pretension to dictate the conduct of others in this matter, I should be reproved by first of these rules. Yet if I were to develop the reasons the force of which I feel myself, I presume they would have weight with others.

Those reasons would embrace, in the first place, the consideration that the woof and warp of all thought and all research is symbols, and the life of thought and science is the life inherent in symbols; so that it is wrong to say that a good language is *important* to good thought, merely; for it is of the essence of it. Next would come the consideration of the increasing value of precision of thought as it advances. Thirdly, the progress of science cannot go far except by collaboration; or, to speak more accurately, no mind can take one step without the aid of other minds. Fourthly, the health of the scientific communion requires the most absolute mental freedom. Yet the scientific and philosophical worlds are infested with pedants and pedagogues who are continually endeavoring to set up a sort of magistrature over thoughts and other symbols. It thus becomes one of the first duties of one who sees what the situation is, energetically to resist everything like arbitrary dictation in scientific affairs, and above all, as to the use of terms and notations. At the same time, a general agreement concerning the use of terms and of notations, — not too rigid, yet prevailing, with most of the co-workers in regard to most of the symbols, to such a degree that there shall be some small number of different systems of expression that have to be mastered, — is indispensable. Consequently, since this is not to be brought about by arbitrary dictation, it must be brought about by the power of rational principles over the conduct of men.

Now what rational principle is there which will be perfectly determinative as to what terms and notations shall be used, and in what senses, and which at the same time possesses the requisite power to influence all right-feeling and thoughtful men?

In order to find the answer to that question, it is necessary to consider, first, what would be the character of an ideal philosophical terminology and system of logical symbols; and, secondly, to inquire

what the experience of those branches of science has been that have encountered and conquered great difficulties of nomenclature, etc., in regard to the principles which have proved efficacious, and in regard to unsuccessful methods of attempting to produce uniformity.

As to the ideal to be aimed at, it is, in the first place, desirable for any branch of science that it should have a vocabulary furnishing a family of cognate words for each *scientific* conception, and that each word should have a single exact meaning, unless its different meanings apply to objects of different catagories that can never be mistaken for one another. To be sure, this requisite might be understood in a sense which would make it utterly impossible. For every symbol is a living thing, in a very strict sense that is no mere figure of speech. The body of the symbol changes slowly, but its meaning inevitably grows, incorporates new elements and throws off old ones. But the effort of all should be to keep the *essence* of every scientific term unchanged and exact; although absolute exactitude is not so much as conceivable. Every symbol is, in its origin, either an image of the idea signified, or a reminiscence of some individual occurrence, person or thing, connected with its meaning, or is a metaphor. Terms of the first and third origins will inevitably be applied to different conceptions; but if the conceptions are strictly analogous in their principal suggestions, this is rather helpful than otherwise, provided always that the different meanings are remote from one another, both in themselves and in the occasions of their occurrence. Science is continually gaining new conceptions; and every new *scientific* conception should receive a new word, or, better a new family of cognate words. The duty of supplying this word naturally falls upon the person who introduces the new conception; but it is a duty not to be undertaken without a thorough knowledge of the principles and a large acquaintance with the details and history of the special terminology in which it is to take a place, nor without a sufficient comprehension of the principles of word-formation of the national language, nor without a proper study of the laws of symbols in general. That there should be two different terms of identical scientific value may or may not be an inconvenience, according to circumstances. Different systems of expression are often of the greatest advantage.

The ideal terminology will differ somewhat for different sciences. The case of philosophy is very peculiar in that it has positive need of popular words in popular senses, — not as its own language (as it has too usually used those words), but as objects of its study. It

thus has a peculiar need of a language distinct and detached from common speech, such a language as Aristotle, the scholastics, and Kant endeavored to supply, while Hegel endeavored to destroy it. It is good economy for philosophy to provide itself with a vocabulary so outlandish that loose thinkers shall not be tempted to borrow its words. Kant's adjectives "objective" and "subjective" proved not to be barbarous enough, by half, long to retain their usefulness in philosophy, even if there had been no other objection to them. The first rule of good taste in writing is to use words whose meanings will not be misunderstood; and if a reader does not know the meaning of the words, it is infinitely better that he should know he does not know it. This is particularly true in logic, which wholly consists, one might almost say, in exactitude of thought.

The sciences which have had to face the most difficult problems of terminology have unquestionably been the classificatory sciences of physics, chemistry, and biology. The momenclature of chemistry is, on the whole, good. In their dire need, the chemists assembled in congress, and adopted certain rules for forming names of substances. Those names are well-known, but they are hardly used. Why not? Because the chemists were not psychologists, and did not know that a congress is one of the most impotent of things, even less influential by far than a dictionary. The problem of the biological taxonomists has, however, been incomparably more difficult; and they have solved it (barring small exceptions) with brilliant success. How did they accomplish this? Not by appealing to the power of congresses, but by appealing to the power of the idea of right and wrong. For only make a man *really see* that a certain line of conduct is wrong, and he *will* make a strong endeavor to do the right thing, — be he thief, gambler, or even a logician or moral philosopher. The biologists simply talked to one another, and made one another see that when a man has introduced a conception into science, it naturally becomes both his privilege and his duty to assign to that conception suitable scientific expressions; and that when a name has been conferred upon a conception by him to whose labors science is indebted for that conception, it becomes the duty of all — a duty to the discoverer, and a duty to science — to accept his name, unless it should be of such a nature that the adoption of it would be unwholesome for science; that should the discoverer fail in his duty, either by giving no name or an utterly unsuitable one, then, after a reasonable interval, whoever first has occasion to employ

a name for that conception must invent a suitable one; and others ought to follow him; but that whoever deliberately uses a word or other symbol in any other sense than that which was conferred upon it by its sole rightful creator commits a shameful offence against the inventor of the symbol and against science, and it becomes the duty of the others to treat the act with contempt and indignation.

As fast as the students of any branch of philosophy educate themselves to a genuine scientific love of truth to the degree to which the scholastic doctors were moved by it, suggestions similar to those above will suggest themselves; and they will consequently form a technical terminology. In logic, a terminology more than passably good has been inherited by us from the scholastics. This scholastic terminology has passed into English speech more than into any other modern tongue, rendering it the most logically exact of any. This has been accompanied by the inconvenience that a considerable number of words and phrases of scientific logic have come to be used with a laxity quite astounding. Who, for example, among the dealers in Quincy Hall who talks of "articles of *prime necessity*," would be able to say what that phrase "prime necessity" strictly means? He could not have sought out a more technical phrase. There are dozens of other loose expressions of the same provenance.

Having thus given some idea of the nature of the reasons which weigh with me, I proceed to state the rules which I find to be binding upon me in this field.

First. To take pains to avoid following any recommendation of an arbitrary nature as to the use of philosophical terminology.

Second. To avoid using words and phrases of vernacular origin as technical terms of philosophy.

Third. To use the scholastic terms in their anglicised forms for philosophical conceptions, so far as they are strictly applicable; and never to use them in other than their proper senses.

Fourth. For ancient philosophical conceptions overlooked by the scholastics, to imitate, as well as I can, the ancient expression.

Fifth. For precise philosophical conceptions introduced into philosophy since the middle ages, to use the anglicised form of the original expression, if not positively unsuitable, but only in its precise original sense.

Sixth. For philosophical conceptions which vary by a hair's breadth from those for which suitable terms exist, to invent terms with a due regard for the usages of philosophical terminology and those of the English language but yet with a distinctly technical

appearance. Before proposing a term, notation, or other symbol, to consider maturely whether it perfectly suits the conception and will lend itself to every occasion, whether it interferes with any existing term, and whether it may not create an inconvenience by interfering with the expression of some conception that may hereafter be introduced into philosophy. Having once introduced a symbol, to consider myself almost as much bound by it as if it had been introduced by somebody else; and after others have accepted it, to consider myself more bound to it than anybody else.

SEVENTH. To regard it as needful to introduce new systems of expression when new connections of importance between conceptions come to be made out, or when such systems can, in any way, positively subserve the purposes of philosophical study.

EXISTENTIAL GRAPHS.

THE CONVENTIONS.

ALPHA PART.

Convention No. Zero. Any feature of these diagrams that is not expressly or by previous conventions of languages required by the conventions to have a given character may be varied at will. This "convention" is numbered zero, because it is understood in all agreements.

Convention No. I. ¶ 1. These Conventions are supposed to be mutual understandings between two persons: a *Graphist*, who expresses propositions according to the system of expression called that of *Existential Graphs*, and an *Interpreter*, who interprets those propositions and accepts them without dispute.

A *graph* is the propositional expression in the System of Existential Graphs of any possible state of the universe. It is a Symbol, and, as such, general, and is accordingly to be distinguished from a *graph-replica*. A graph remains such though not actually asserted. An expression, according to the conventions of this system, of an impossible state of things (conflicting with what is taken for granted at the outset or has been asserted by the graphist) is not a graph, but is termed *The pseudograph*, all such expressions being equivalent in their absurdity.

¶ 2. It is agreed that a certain sheet, or blackboard, shall, under the name of *The Sheet of Assertion*, be considered as representing the universe of discourse, and as asserting whatever is taken for granted between the graphist and the interpreter to be true of that universe. The sheet of assertion is, therefore, a graph. Certain parts of the sheet, which may be severed from the rest, will not be regarded as any part of it.

¶ 3. The graphist may place replicas of graphs upon the sheet of assertion; but this act, called *scribing* a graph on the sheet of assertion, shall be understood to constitute the assertion of the truth of the graph scribed. [Since by ¶ 1 the conventions are only "supposed to be" agreed to, the assertions are mere pretence in studying logic. Still they may be regarded as actual assertions con-

cerning a fictitious universe.] "Assertion" is not defined; but it is supposed to be permitted to scribe some graphs and not others.

Corollary. Not only is the sheet itself a graph, but so likewise is the sheet together with the graph scribed upon it. But if the sheet be blank, this *blank*, whose existence consists in the absence of any scribed graph, is itself a graph.

Convention No. II. ¶ 1. A graph-replica on the sheet of assertion having no scribed connection with any other graph-replica that may be scribed on the sheet shall, as long as it is on the sheet of assertion in any way, make the same assertion, regardless of what other replicas may be upon the sheet.

The graph which consists of all the graphs on the sheet of assertion, or which consists of all that are on any one area severed from the sheet, shall be termed the *entire* graph of the sheet of assertion or of that area, as the case may be. Any part of the entire graph which is itself a graph shall be termed a *partial* graph of the sheet or of the area on which it is.

Corollaries. Two graphs scribed on the sheet are, both of them, asserted, and any entire graph implies the truth of all its partial graphs. Every blank part of the sheet is a partial graph.

Convention No. III. ¶ 1. By a *Cut* shall be understood to mean a self-returning linear separation (naturally represented by a fine-drawn or peculiarly colored line) which severs all that it encloses from the sheet of assertion on which it stands itself, or from any other area on which it stands itself. The whole space within the cut (but not comprising the cut itself) shall be termed the *area* of the cut. Though the area of the cut is no part of the sheet of assertion, yet the cut together with its area and all that is on it, conceived as so severed from the sheet, shall, under the name of the *enclosure* of the cut, be considered as on the sheet of assertion or as on such other area as the cut may stand upon. Two cuts cannot intersect one another, but a cut may exist on any area whatever. Any graph which is unenclosed or is enclosed within an even number of cuts shall be said to be *evenly enclosed*; and any graph which is within an odd number of cuts shall be said to be *oddly enclosed*. A cut is not a graph; but an enclosure is a graph. The sheet or other area on which a cut stands shall be called the *place* of the cut.

A pair of cuts, one within the other but not within any other cut that that other is not within, shall be called a *scroll*. The outer cut of the pair shall be called the *outloop*, the inner cut the *inloop*, of the scroll. The area of the inloop shall be termed the *inner close* of

the scroll; the area of the outloop, *excluding the enclosure of the inloop* (and not merely its area), shall be termed the *outer close* of the scroll.

The enclosure of a scroll (that is, the enclosure of the outer cut of the pair) shall be understood to be a graph having such a meaning that if it were to stand on the sheet of assertion, it would assert *de inesse* that if the entire graph in its outer close is true, then the entire graph in its inner close is true. No graph can be scribed across a cut, in any way; although an enclosure is a graph.

[A conditional proposition *de inesse* considers only the existing state of things, and is, therefore, false only in case the consequent is false while the antecedent is true. If the antecedent is false, or if the consequent is true, the conditional *de inesse* is true.]

¶ 2. The filling up of any entire area with whatever writing material (ink, chalk, etc.) may be used shall be termed *obliterating* that area, and shall be understood to be an expression of the pseudo-graph on that area.

Corollary. Since an obliterated area may be made indefinitely small, a single cut will have the effect of denying the entire graph in its area. For to say that if a given proposition is true, everything is true, is equivalent to denying that proposition.

Beta Part.

Convention No. IV. ¶ 1. The expression of a rheme in the system of existential graphs, as simple, that is without any expression, according to these conventions, of the analysis of its signification, and such as to occupy a superficial portion of the sheet or of any area shall be termed a *spot*. The word "spot" is to be used in the sense of a *replica*; and when it is desired to speak of the symbol of which it is the replica, this shall be termed a *spot-graph*. On the periphery of every spot, a certain place shall be appropriated to each blank of the rheme; and such a place shall be called a *hook* of the spot. No spot can be scribed except wholly in some area.

¶ 2. A heavy *dot* scribed at the hook of a spot shall be understood as filling the corresponding blank of the rheme of the spot with an indefinite sign of an individual, so that when there is a dot attached to every hook, the result shall be a proposition which is particular in respect to every subject.

Convention No. V. ¶ 1. Every heavily marked point, whether isolated, the extremity of a heavy line, or at a furcation of a heavy

line, shall denote a single individual, without in itself indicating what individual it is.

¶ 2. A heavily marked line without any sort of interruption (though its extremity may coincide with a point otherwise marked) shall, under the name of *a line of identity*, be a graph, subject to all the conventions relating to graphs, and asserting precisely the identity of the individuals denoted by its extremities.

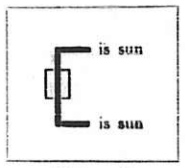
Corollaries. It follows that no line of identity can cross a cut.

Also, a point upon which three lines of identity abut is a graph expressing the relation of *teridentity*.

¶ 3. A heavily marked point may be on a cut; and such a point shall be interpreted as lying in the place of the cut and at the same time as denoting an individual identical with the individual denoted by the extremity of a line of identity on the area of the cut and abutting upon the marked point on the cut. Thus, in

(Fig. 10.)

Fig. 10, if we refer to the individual denoted by the point where the two lines meet on the cut, as X, the assertion is, "Some individual, X, of the universe is a man, and nothing is at once mortal and identical with X;" *i. e.*, some man is not mortal. So in Fig. 11, if X and Y are the individuals denoted by the points on the inner cut, the interpretation is,



(Fig. 11.)

"If X is the sun and Y is the sun, X and Y are identical."

A collection composed of any line of identity together with all others that are connected with it directly or through still others is termed a *ligature*. Thus ligatures often cross cuts, and, in that case, are not graphs.

Convention No. VI. ¶ 1. A symbol for a single individual, which individual is more than once referred to, but is not identified as the object of a proper name, shall be termed a *Selective*. The capital letters may be used as selectives, and may be made to abut upon the hooks of spots. Any ligature may be replaced by replicas of one selective placed at every hook and also in the outermost area

that it enters. In the interpretation, it is necessary to refer to the outermost replica of each selective first, and generally to proceed in the interpretation from the outside to the inside of all cuts.

Gamma Part.

Convention No. VII. ¶ 1. The following spot-symbols shall be used, as if they were ordinary spot-symbols, except for special rules applicable to them: [Selectives are placed against the hooks in order to render the meanings of the new spot-symbols clearer].

A q, A is a monadic character;
A r, A is a dyadic relation;
A s, A is a triadic relation;
X $\bigwedge_0$, X is a proposition or fact;
X $\bigwedge\!\!\bigwedge$ Y, Y possesses the character X;
X $\bigwedge_1^{Y}{}_{Z}$, Y stands in the dyadic relation X to Z;
X $\bigwedge_2^{Y}{}_{W}$ Z, Y stands in the triadic relation X to Z for W.

Convention No. VIII. ¶ 1. A cut with many little interruptions aggregating about half its length shall cause its enclosure to be a graph, expressing that the entire graph on its area is logically contingent (non-necessary).

Convention No. IX. ¶ 1. By a *rim* shall be understood an oval line making it, with its contents, the expression either of a rheme or a proper name of an *ens rationis*. Such a rim may be drawn as a line of peculiar texture, or a gummed label with a colored border may be attached to the sheet. A dotted rim containing a graph, some part of which is itself enclosed by a similar inner dotted oval and with heavy dotted lines proceeding from marked points of this graph to hooks on the rim, shall be a spot expressing that the individuals denoted by lines of identity attached to the hooks (or the single such individual) have the character constituted by the truth of the graph to be possessed by the individuals denoted by those points of it to which the heavy dotted lines are attached, in so far as they are connected with the partial graph within the inner oval.

¶ 2. A rim represented by a wavy line containing a graph, of which some marked points are connected by wavy lines with hooks on the rim, shall be a spot expressing that the individuals denoted by lines of identity abutting on these hooks form a collection of

sets of which collection each set has its members characterized in the manner in which those individuals must be which are denoted by the points of attachment of the interior graph, when that graph is true.

¶ 3. A rim shown as a saw line denotes an individual collection of individual single objects or sets of objects, the members of the collection being all those in existence which are such individuals as the truth of the graph within makes those to be that are denoted by points of attachment of that graph to saw lines passing to hooks of the rim.

RULES OF TRANSFORMATION.

PURE MATHEMATICAL DEFINITION OF EXISTENTIAL GRAPHS, REGARDLESS OF THEIR INTERPRETATION.

I. Alpha Part.

1. The *System of Existential Graphs* is a certain class of diagrams upon which it is permitted to operate certain transformations.

2. There is required a certain surface upon which it is practicable to scribe the diagrams and from which they can be erased in whole or in part.

3. The whole of this surface except certain parts which may be severed from it by "cuts" is termed the *sheet of assertion.*

4. A *graph* is a legisign (*i. e.*, a sign which is of the nature of a general type) which is one of a certain class of signs used in this system. A *graph-replica* is any individual instance of a graph. The sheet of assertion itself is a graph-replica; and so is any part of it, being called the *blank.* Other graph-replicas can be scribed on the sheet of assertion, and when this is done the graphs of which those graph-replicas are instances is said to be "scribed on the sheet of assertion"; and when a graph-replica is erased, the graph is said to be erased. Two graphs scribed on the sheet of assertion constitute one graph of which they are said to be *partial graphs.* All that is at any time scribed on the sheet of assertion is called the *entire scribed graph.*

5. A *cut* is a self-returning finely drawn line. A cut is not a graph-replica. A cut drawn upon the sheet of assertion severs the surface it encloses, called the *area* of the cut, from the sheet of assertion; so that the area of a cut is no part of the sheet of assertion. A cut drawn upon the sheet of assertion together with its area and whatever is scribed upon that area constitutes a graph-replica scribed upon the sheet of assertion, and is called the *enclosure* of the cut. Whatever graph might, if permitted, be scribed upon the sheet of assertion might (if permitted) be scribed upon the area of any cut. Two graphs scribed at once on such area constitute a graph, as they would on the sheet of assertion. A cut can (if permitted) be drawn upon the area of any cut, and will sever the surface which it encloses from the area of the cut, while the enclosure of such inner cut will be a graph-replica scribed on the area of the outer cut. The sheet of assertion is also an area. Any blank part of any area is a graph-replica. Two cuts one of which has the enclosure of the other on its area and has nothing else there constitute a *double cut.*

6. No graph or cut can be placed partly on one area and partly on another.

7. No transformation of any graph-replica is permitted unless it is justified by the following code of Permissions.

CODE OF PERMISSIONS.

Permission No. 1. *In each special problem such graphs may be scribed on the sheet of assertion as the conditions of the special problem may warrant.*

Permission No. 2. *Any graph on the sheet of assertion may be erased, except an enclosure with its area entirely blank.*

Permission No. 3. *Whatever graph it is permitted to scribe on the sheet of assertion, it is permitted to scribe on any unoccupied part of the sheet of assertion, regardless of what is already on the sheet of assertion.*

Permission No. 4. *Any graph which is scribed on the inner area of a double cut on the sheet of assertion may be scribed on the sheet of assertion.*

Permission No. 5. *A double cut may be drawn on the sheet of assertion; and any graph that is scribed on the sheet of assertion may be scribed on the inner area of any double cut on the sheet of assertion.*

Permission No. 6. *The reverse of any transformation that would be permissible on the sheet of assertion is permissible on the area of any cut that is upon the sheet of assertion.*

Permission No. 7. *Whenever we are permitted to scribe any graph we like upon the sheet of assertion, we are authorized to declare that the conditions of the special problem are absurd.*

II. Beta Part.

8. The beta part adds to the alpha part certain signs to which new permissions are attached, while retaining all the alpha signs with the permissions attaching to them.

9. The *line of identity* is a Graph any replica of which, also called a line of identity, is a heavy line with two ends and without other topical singularity (such as a point of branching or a node), not in contact with any other sign except at its extremities. Otherwise, its shape and length are matters of indifference. All lines of identity are replicas of the same graph.

10. A *spot* is a graph any replica of which occupies a simple bounded portion of a surface, which portion has qualities distinguishing it from the replica of any other spot; and upon the boundary of the surface occupied by the spot are certain points, called the *hooks* of the spot, to each of which, if permitted, one extremity of one line of identity can be attached. Two lines of identity cannot be attached to the same hook; nor can both ends of the same line.

11. Any indefinitely small dot may be a spot replica called a *spot of identity*, and three lines of identity may be attached to such a spot. Two lines of identity one outside a cut and the other on the area of the same cut may have each an extremity at the same point on the cut. The totality of all the lines of identity that join one another is termed a *ligature*. A ligature is not generally a graph, since it may be part in one area and part in another. It is said to lie within any cut which it is wholly within.

12. The following are the additional permissions attaching to the beta part.

CODE OF PERMISSIONS, — *Continued.*

Permission No. 8. *All the above permissions apply to all spots and to the line of identity, as Graphs; and Permission No. 2 is to be understood as permitting the erasure of any portion of a line of identity on the sheet of assertion, so as to break it into two. Permission No. 3 is to be understood as permitting the extension of a line of identity on the sheet of assertion to any unoccupied part of the sheet of assertion. Permission No. 3 must not be understood as implying that because it is permitted to scribe a graph without certain ligatures, therefore it is permissible to scribe it with them, or the reverse.*

Permission No. 9. *It is permitted to scribe an unattached line of identity on the sheet of assertion, and to join such unattached lines*

in any number by spots of identity. This is to be understood as permitting a line of identity, whether within or without a cut, to be extended to the cut, although such extremity is to be understood to be on both sides of the cut. But this does not permit a line of identity within a cut that is on the sheet of assertion to be retracted from the cut, in case it extends to the cut.

Permission No. 10. *If two spots are within a cut (whether on its area or not), and are not joined by any ligature within that cut, then a ligature joining them outside the cut is of no effect and may be made or broken. But this does not apply if the spots are joined by other hooks within the cut.*

Permission No. 11. *Permissions Nos. 4 and 5 do not cease to apply because of ligatures passing from without the outer of two cuts to within the inner one, so long as there is nothing else in the annular area.*