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The SEETEE Mind

by GOTTHAHD GÜNTHER [*]

A Challenge to Modern Logic !

MODERN logic may have begun with Aristotle, but it will not end with him. For 2000 years Aristotle's two-valued system has been so engrooved upon our mind that any other way of thinking is difficult and painful. A fact is either true or false – can there be any other possibility? In a pre-atomic universe perhaps there couldn't, but now we discover uncomfortable moments when a fact may be neither true nor false, but something else. Just as Euclidean physics, which explained nothing, had to yield to Einsteinean physics which once grasped are self-evident, so two-valued logic must yield to three.

The series of articles initiated here by Dr. Günther, eminent metaphysician, are genuinely trail-blazing. Most of what he offered as the latest word in science is a rehash of stuff old to any conscientious researcher. This material is new, the first new concept in 2000 years of philosophical thinking. Trying it on my hurt like a pair of new shoes but once broken in you will find it more serviceable. And you may never think in alternative values again.

- The Editor

- part 1 of 4 -

You must have wondered what would happen if a terrestrial space-ship, traveling to some distant portion of our galactic universe, were to encounter strange beings with absolutely alien minds. How would the two parties react, and how would they establish communication – if any? We meet people with supposedly "alien" mentality even on this planet. You have only to make a world tour to see the pygmies in equatorial Africa, the Weddas in Ceylon or the Dravidian races in India. But it's easy to talk to a Dravida – if you know Tanil, Kanarese or any other of the Dravidian languages.

Some people draw the line even closer. I know a Texan for whom all non-Texan inhabitants of the United States are beings with foreign tastes and alien minds. But even a Texan can talk to a New Yorker – if he wants to. And if you want to talk to a Dravida you buy yourself a Kanarese grammar and dictionary. You'll get along somehow. Misunderstandings can be corrected, and are sometimes amusing. I recall once in Italy when I wanted cold water and ordered the waiter to bring me "aqua caldo". He returned with a pot of warm water. I shook my head and repeated: "caldo, caldo!" He brought me steaming water. When I refused again and shouted "caldo" at the top of my lungs I got boiling water. A look in the dictionary told me that "aqua calda" in Italian means *warm* water. "Cold" is "freddo" (frigid).

Such mentalities are not alien at all. They produce identical thoughts, but convey them by different languages. Human ideas are the same everywhere on this planet. Only the vocal and written expressions of them are different. That is why we use the general term "man-kind". *Man* is spiritually of the same *kind* wherever you find him on this planet. Incidentally, though the modes of expression might differ to a far greater degree than they do among peoples of our world, the mind acting behind the alien system of expression might still be the same as ours.

Murray Leinster's fine story "First Contact" describes the encounter between a terrestrial spaceship and an alien vessel from unknown regions of our galaxy. The members of that alien crew possessed bodies physiologically unlike our own. They saw by heatwaves, and breathed through gills. More-

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over, they were unable to produce vowel and consonant sounds in vocal speech. They communicated instead by frequency-modulation of variable wave lengths. Consequently any "language" communication went directly from brain to brain without the help of any acoustic, tactile, olfactory or visual medium. This poses quite a problem for translation. But as this system of frequency-modulation with variable wave lengths is still a *language system* – even though of non-terrestrial origin – the problem is simply one of translation and is fundamentally no different from translating Shakespeare into German or Newton into Chinese. Leinster takes care to point out that the intellects behind the two different systems of communication – terrestrial and non-terrestrial – are basically the same. During the attempts to establish communication, Leinster writes, one terrestrial crew member "essayed a mild joke". It had to be translated into code numerals, then into cryptic groups of short-wave, frequency-modulation impulses; these went to the other ship and into heaven-knows-what to become intelligible. A joke which went through such formalities would not seem likely to be funny. But the alien saw the point. There can be no doubt that if people enjoy the same jokes their mentalities *must* be structurally identical, and only the mode of communication differs. Leinster finds this issue, important enough to bring up again at the end of his story. Before the two spaceships part, an alien reports to his own skipper, "You see, sir, spent those two hours telling dirty jokes". This is fairly profound. Only if two intelligences are akin to each other down to the very root of procreation are they really alike.

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Obviously the aliens in Leinster's story are "alien" in the same way as the Dravidas are to us or a New Yorker is to a Texan. Actually they belong to a larger cosmic concept of man-kind because they are spiritually the same kind as the terrestrial man, and form together with him a greater community of rational life within our universe. This raises the interesting question: *May we* ever *encounter rational intelligences of extraterrestrial origin which do not belong to that greater community of cosmic mankind?* Intelligent beings outside of that community would have a truly alien mind. In such a case more than the system of rational expression and communication would differ. Even the mind activating its language would be different and capable of producing thoughts which mankind never having conceived could never grasp in all the future history of our universe.

Understandably, the author of this article knows no more about the existence of such alien intelligences than anybody else. It is still possible, however, to answer the question of whether theoretically at least, the existence of such alien minds is possible, and, if the answer is affirmative – as it will be – how such a mind must differ from our own.

To find out whether the existence of genuine alien intelligences (so alien that mere language translation would never establish a common understanding) is theoretically possible, we must first ask the following question: what are the basic conditions of existence for the human mind and all the other hypothetical extraterrestrial minds which follow the same rational system of thinking as we do? The answer is simple: in order to work and to recognize the world intelligently the mind must – in its own structure – *repeat* the basic properties of general physical existence.

Let me illustrate: if our world contained only the two colors "green" and "blue", and if our retina could react only to the colors "red" and "yellow", then we would not perceive our surroundings at all and would have no conception of what they are really like. In order to obtain true knowledge, our eyes must "repeat" the objective properties blue and green. Let us generalize from this and switch from the specific color situation to the comprehensive relation between general physical existence and the human mind. Everybody knows that the world is made up of matter. If you have more detailed knowledge – and readers of science fiction usually have – then you know that matter consists of elementary particles called protons, electrons, neutrons and positrons. To these, we can add photons, gravitons, neutrinos, and many others. The number of these particles is not important for

us. However what is important is that all these particles, and any as yet unknown corpuscles, display three fundamental energetic properties. They carry either:

a positive electric charge
a negative charge
no charge at all.

It stands to reason that if the human mind produces its knowledge by repeating the basic properties of the world around it, it will also repeat in its own brain mechanism the energetic qualities of physical existence. Consequently, our brain is made up of a system of neurons that are equipped for two – and only two reactions a positive and a negative one. Now, don't stop my argument with the objection that if physical existence has *three* fundamental energy states then the repeating neurons of the human brain should be capable of *three* reactions. There's a flaw in such reasoning. Our mind is supposed to repeat the basic qualities of physical existence. These qualities are energetic. There are only two definable ones - positive and negative charge – and there is a third electrically undefinable one: no electric quality at all. Manifestly, while our brain can, in its functions, repeat definite qualities, it cannot repeat *no quality* in any definite way. This is why consciousness judges matter as impenetrable. There is something in matter the mind does not repeat. That is why the metaphysician says that the very core of matter is transcendental.

Our organic brain repeats in its own functional organization the two active properties of physical existence. That is a first and physical repetition. But if we observe the rational laws according to which our brain works and describe them in a theory of logic we repeat this basic structure of physical existence a second time in one consciousness. We say then: our intelligence works with basic concepts of thought which have two fundamental qualities. They are either positive or negative. True or false. Objective or subjective. Individual or general. These alternatives may be continued endlessly and they are referred to when we say that the human mind uses a two-valued logic. These two values (no matter what you call them) repeat in their turn the "on" and "off"' positions of the neuronic switches in our brain. The latter repeats (as we pointed out before) the positive and negative electric charge of the particles of which our physical world is composed.

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We can see that all rational beings – terrestrial or galactic – must necessarily have the same brain-structure and use the same logic if they face the same universe and are physically composed of the same matter. The two-valued logic which corresponds exactly to the structure of physical existence as we know it, is Aristotelian logic. All rational beings – provided they inhabit our universe – are therefore "Aristotelian" intelligences. If we meet a foreign race, let us say in the neighborhood of the Crab Nebula, the difficulty of translating their language may be technically extreme. Nevertheless, the task will not be impossible because the mind which functions behind any bizarre pattern of language is still the same as our own. It is two-valued and follows precisely the rational laws that govern the terrestrial mind. Our friend from the Crab Nebula may have tentacles and breathe through gills, but his mind will follow Aristotelian patterns just the same. His is, spiritually speaking, the same *kind* as terrestrial man. The philosophic concept of mankind is not confined to Terra. It comprises all rational beings in a universe that is composed of one single type of physical matter.

This, however, is but half, the story. There exists a theoretical possibility of contraterrene matter – c/t or, for convenience, "seetee". Contraterrene matter is a state of material existence where the elementary particles have reversed their electrical charges. Electrons which, are known to have a negative charge in terrene matter will carry a positive charge if they belong to seetee matter, and protons would display the properties of negative electricity if they occur contraterrene forms of physical existence. Rational beings living in a seetee world must have a seetee organism and a brain with reversed neuronic reactions. As their logic repeats the functional characteristics of their brain-

matter, the thinking of the hypothetical seetee intelligence must be determined by an inverted system of logical values. Where in Aristotelian thought processes the positive logical value is attached to a certain concept, a seetee being must treat the same concept as negative, and where the terrene minds use negations, the being from a contraterrene world will introduce positive terms of thought. The seetee mind is the total contradiction of the terrene mind. It is two-valued too, but it is contra-Aristotelian.[1]

Let us ignore the fantastic physical difficulties of ever meeting seetee intelligences. But if we succeeded in contacting a seetee race, no mere language translator would be adequate. Seetee jokes would not be our jokes, and seetee logical conclusions would not have validity for our mind. In addition to the language translator, we would need an infinitely more intricate gadget - genuine thought translator.

The seetee mind would be based on total reversal of logical values. We are all familiar with a so-called partial reversal of logical values. This is a tacit way of saying that we are all liars when the occasion demands it. In practical the logical values are "true" and "false". In a statement, if I replace the true predicate with its negation, the statement becomes false. Five minutes ago the telephone rang. I did not wish to be interrupted. Since I am able to imitate little girls´ voices over the telephone the party at the other end was greeted by a child's voice: "Mister Günther is not in." This of course was a plain case of lie – pardon me – of reversal logical values. The positive predicate was replaced by its negation "not in".

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The being with the contraterren mind is in relation to us and on truth-conception "the absolute liar". But don't jump to conclusions. It may be relatively true that if you ring the bell and the seetee butler in a seetee world tells you that "Mr. So-and-so is not at home", he is sitting right in his study and expecting you to come in. Such a simple case is exceptional, and your own experience in lying makes simple to find out what is (for you) the true statement. But if things become a little more involved, you will not be able to keep up with the statements of the seetee butler. The reason for this is that we are only partial liars and use only unconnected simple alternatives when we intend to make a false statement. The interrogation technique of the police is based on the fact that we are only capable of incomplete lies. Our statements are always an inextricable mixture of true and false terms and therefore logically inconsistent. The seetee mind, so far as we are concerned, is the complete and consistent "liar". All his statements are – judged by terrene standards – untrue. Truth, however, is more systematic consistency than anything else. It is the total absence of contradictions. The "lies" of a contraterrene intelligence are "true" to a seetee being as long as they do not contain inherent contradictions. They do not deny each other. They simply deny our terrene viewpoint.

I once discussed this question in a course on formal logic at a New England college. A bright young thing in the classroom said, "Oh, it must be easy to adopt an alien mentality. If I never forget to lie I shall actually be thinking in terms of a non-human intelligence."

"You are mistaken", I said. "The question is not whether or not you forget to lie, but whether you actually know the consistent lie in instance. What, for instance, is the exact reversal of logical values in the statement: This color is green? It is 'not green' of course. We all know that. But what is 'not green'? Is it orange, red, blue, yellow or what? As this case is still very simple I happen to know the right answer which would be given by the 'total liar'. It is 'This color is purple'".

This is the only answer which will not involve you in contradictions, but to find it you will have to have very specific knowledge about our color-system. In order to lie about everything consistently you would have to know all about everything. This, however, is the prerogative of the divine mind.

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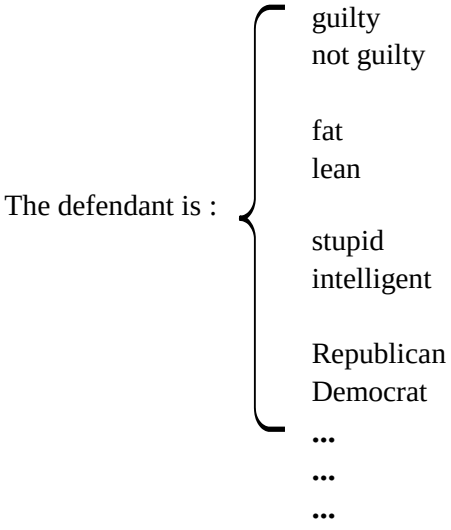
1 For the idea that personal subjects can only think in two-valued terms I am indebted to John W. Campbell, Jr.–G.G.

To know that purple is the logical opposite of green you need only know enough about one single system - that of color. The task of finding a seetee predicate becomes impossible for any human being if the array of negative predicates that contradict a positive statement is distributed over an unknown number of systems with different semantic characteristics. You want, for instance, to obtain two complete statements - one in terrene and one in contraterrene terms. The array of predicates is as follows:



Now the statement: guilty-fat-intelligent Republican, may be the terrene viewpoint. Then it seems that the contraterrene series of predicates is: not guilty-lean-stupid-Democrat.[2] This, however, is a serious mistake. Unless we know *all* the predicates for the terrene viewpoint we cannot establish a single predicate for the seetee mentality because one as yet unknown terrestrial predicate might cancel out any of the alternatives. Let us assume one of the later predicate, not in the above array, to be "Russian". This would automatically cancel the alternative:

There ain't no such animal in Russia! But as we will never know all the predicates that are implied for a certain sentence by terrene mentality, it is impossible for us to establish even one pertinent predicate that belongs to the contraterrene intelligence. The difficulty is that the series of possible predicates implied by a single statement is infinite, and to find the negation of a whole series you must first negate each predicate individually.

This is patently impossible.

It follows that all negations are indefinite and equivocal. This is amusingly illustrated by the famous "proof" of a medieval logician that a cat has three tails. It goes as follows:

No cat has two tails.
One cat has one more tail than no cat.

One cat has three tails.

The infinite range of possible negations of a single statement is demonstrated by the fact that you could "prove" your case for any number of tails, because it is equally true that no cat has seven or seven-hundred tails. A similar problem of negation is illustrated by the following anecdote. An irate

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2 Note: the distribution of the predicates does not reflect the political convictions of the author.

reporter once wrote: "Half the members of our parliament are imbeciles." He was taken to court and the judge ordered him to publish a retraction of his statement.

He next wrote: "My previous statement is untrue – half the members of our parliament are not imbeciles."

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What I want to emphasize is this: The capacity for logical negations which we possess does not carry us across the immeasurable gulf that exists between an Aristotelian mind and an inverted Aristotelian intelligence. And no other type of alien mentality can possibly exist, in terms of our present understanding of the nature of matter. The seetee mind is the only physical possibility. Its whole range of thoughts would be a total negation of our thoughts. However, we can never reach that hypothetical seetee mind by negation of our thoughts because any negation we perform remains partial and therefore equivocal and indefinite. Our negations simply remain *inside* our own terrene range of thought. We are not capable of that radical step of total negation which carries across the gulf from the Aristotelian to the contra-Aristotelian mind. No rational being can consciously perform a total negation because in order to perform it the intelligence in question would have to negate not only *all* its statements, but in addition negate the existence of its own mind. This radical reversal would be meant: suicide.

Total negation, then, is that which not only negates all the contents of a certain mind but also the mind itself. In fact total negation is the logical definition of death.

Our instinct of self-preservation always prompts us to minimize negation and to split them up into weaker form of negative statements. For instance, restaurant diner orders a cup of coffee without cream. The waiter returns saying, "Sorry, sir, we are out of cream – how about a cup of coffee without milk?" The diner implied that he wanted neither. This is the stronger negation. The waiter split it up into two weaker forms.

It is absolute death that separates the terrene Aristotelian from the contra Aristotelian seetee mind. The conclusion seems unavoidable that the twin shall never meet. But this issue is not quite settled. The purpose of this article was to demonstrate that no *direct* contact between such minds is possible. No contact, that is, between a terrene and contraterrene ego in which the Aristotelian self intuitively recognizes the spiritual alter ego of the seetee mind. But what about the mechanical brain as a mediator? This brings us to a technical problem: would it be possible to design a mechanical brain on the basis o a three-valued logic which would contain the Aristotelian and the contra-Aristotelian viewpoint as subordinate terms of a specific robot logic? This necessitates an analysis of the idea of three-valued, non-Aristotelian logic. That will be the subject of my next article "Aristotelian and non-Aristotelian Logic".

– part 2 of 4 –

Aristotelian and NON-Aristotelian LOGIC

What kind of thought process should be expected of the seetee alien mind?

There has been much talk of adding to the traditional and classical logic of Aristotle a new technique of thinking which is intended to cover a range of problems the older technique is incapable of dealing with. Since the discovery of German mathematician Karl Fried Gauss (1777-1855) that Euclidean geometry rests on arbitrary axioms and if you replace these axioms by a different set of assumptions you may get a different geometry, logicians have asked themselves whether the same might not apply to a system of logic as well. We now, about one hundred years

after Gauss, that this is indeed the case and by introducing new logical axioms we can indeed develop non-Aristotelian systems of logical calculation. Such calculi already applied to quantum mechanics, they play a tentative part in social sciences, but their most important field will probably be in cybernetics.

It is pretty well established that the human mind can think only in Aristotelian categories. Mechanical brains, however, will work differently and will eventually be able to "think" in non--Aristotelian forms of reasoning.

There is one specific kind of mechanical brain which will not work at all unless it is equipped with the machinery of non-Aristotelian thinking. That is the thought translator. Well and good! But what is a non-Aristotelian thought process? Obviously, to answer this question we must first examine the classic logic of Aristotle. The discovery of formal logic is a very recent affair in the history of mankind. It hardly dates more than twenty-five hundred years back.

The first discovery of formal logic in Ancient Greece – the so-called Sophists – were rather like traveling magicians or first-rate circus performers of our days. You paid your admission and watched the "artist" perform his tricks. He would, for instance, single out a man from the audience and address him as follows, "You admit, sir, that you have that which you have not lost?"

The innocent answer was, "Of course."

"Then, my friend," the Sophist blandly continued, "as you never lost a tail, you must have a tail."

The performer might select a woman known to be a shrew and ask her, "Madam, have you stopped beating your husband? Answer 'yes' or 'no!' " This proved an embarrassing alternative.

Among those laughing at the befuddled woman was a man with a dog. The Sophist turned to him and inquired, "Is this your dog?"

"Yes."

"I see it is a female dog. Has she had puppies?"

The proud owner of the dog affirmed it.

Diabolically the Sophist concluded, "This dog has two properties. First, it is your dog, and second it is mother. Let's add up the predicates: this dog is your mother."

The performer's mental gymnastics were successful because it was little known in pre-Aristotelian times that formal logic is based on a strict technique, and that the skillful "logician" can do amazing tricks when using (or misusing) that technique. Audiences today more sophisticated and not so easily fooled.

Now, if logic is a rational technique it can be technically handled. This is done by the method of propositional calculus Propositional calculus is the technique of combining logical statements according to their truth values. In order to, symbolize any two statements, we use the letters p and q.[[3]] We also use the tilde (~) which is supposed to represent the negation, and a dot (•) which shall have the meaning AND. We therefore read ~ p as NON-p, and p • q as pANDq. The letters p and q may represent any two statements we choose. However, to work with our symbols, ~ and •, we have first to fix their meaning and show how they work. This is done for the negation by the following table:

p	~ p
(true) 1	2 (false)
(false) 2	1 (true)

[3] In the interest of readability we have varied from the standard punctuation of symbolic logic and omitted quotation marks from the symbols preferring the use of capital letters (AND, OR, etc.)

This table indicates that if p is true, then ~p is false, and if p is false, then ~p must be true. Instead of the letter T for true and F for false, we have inserted the first two natural numbers for greater convenience. We will later develop tables for a non-Aristotelian logic, and this can be done more easily by dealing with numbers than with letters.

It is this table which has given Aristotelian logic the name of a two-valued logic. Any statement in this technique of thinking must have one of the two values: it is either true (1) or false (2). No third value exists. True (1) and false (2) are mutually exclusive. The other term • (AND) is similarly defined. AND is supposed to convey a connection between two statements. When we say "the sun shines AND the wind blows", the two independent statements about the sun and wind are merged into a compound-statement by connecting them through the word AND. The problem now is to find out under which logical condition the compound statement shall be true. It stands to reason that the truth of the two independent statements is a question of meteorology rather than of logic. We shall, therefore, give them all possible truth-values. We shall call the statement about the sun p and that about the wind q. We then find that the following combinations are possible:

p		q	
T	1	1	T
T	1	2	F
F	2	1	T
F	2	2	F

The first line under the horizontal bar tells us that both statements are true. According to the second line it is true that the sun shines. But there is no wind. The statement q is false. From the third line we derive that p is false. There is no sunshine; but the second statement is true. The wind does blow. The last line finally informs us that there is neither sun nor wind. Both statements, p as well as q are false. It is evident that the two columns give all possible truth combinations for the two independent statements. But now let us melt these two single statements into a compound statement, "the sun shines AND the wind blows". That raises the question: in which of the above-described cases will the compound statement also be true? We write our compound statement in symbolic form, p • q, and now design a more comprehensive table which contains besides the single statements p and q also the compound elements, p • q:

p		q		p • q		[4]
true	1	1	T	1	T	
true	1	2	F	2	F	
false	2	1	T	2	F	
false	2	2	F	2	F	

It is obvious that the compound statement, "the sun shines and the wind blows" can be true in one and only one case, namely if the sun as well as the wind are active. If there is no wind, then p • q is false. If there is no sun and only wind it is also false. The same applies if there is neither sun nor wind – in other words if p as well as q both have the value 2. The expression p • q is only true if p as well as q are separately true.

By means of this table a logically exact definition of the logical meaning of AND has been obtained. This meaning is used by the electrical calculators if they "think" a conjunction. By the way, the same can be done for the meaning of "OR" in the inclusive or exclusive sense for "IMPLY", for "IS EQUIVALENT TO ", for "IS COMPATIBLE WITH", and for "NEITHER-NOR". There is no need for us to develop the truth tables of all these logical connectives. They can be derived from a

[4] The double line means that the 3rd column is a result of the first two columns

combination of and p • q. The table of negation and the table " AND " together represent the whole propositional truth-structure of Aristotelian logic. They are therefore sufficient basis to develop from there the entire propositional truth-structure of a non-Aristotelian logic.

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Our terran mentality is Aristotelian. There is no doubt about that. But sometimes we meet in life non-Aristotelian situations where our two-valued thinking fails to give us a proper answer. This story, told by an Indian logician, describes such a non-Aristotelian situation.

A Maharajah who kept a large game preserve for his private amusement was constantly troubled by poachers. Losing his patience, he proclaimed that every poacher caught by his guards would suffer capital punishment. Moreover, to add spice to his pronunciamento, the prince decreed that every delinquent facing execution should be privileged to make a statement. If this statement were shown to be true, the condemned man was entitled to beheading; if it proved to be false he should be burned alive. Presently the Maharajah's game warden caught a man shooting deer. On the day of execution the poacher was reminded of his privilege to make a statement. Cleverly he worded it as follows: "I shall be burned alive."

This perplexed the judiciary committee which was to rule on the truth of his statement. The judges were faced with an unavoidable dilemma: if we burn the poacher, then his statement turns out to have been true and he is entitled to a beheading. However, if we chop off his head his statement proves to be false and he should have been burned. At latest reports the committee was still deliberating.

The difference between the Sophistic trick-question and the Indian paradox lies in the fact that the former questions result from the misapplication of the formal rules of Aristotelian logic. It is very easy to rectify them. The dilemma of the condemned poacher on the other hand is not solvable within the confines of the classic logic of Aristotle. Moreover, it suggests a problem that has re-curred within the modern mathematical theory of transfinite sets. So far there exists no genuine solution for it. Only some makeshift procedures have been just instituted by dint of which it is possible to circumvent the awkward dilemma (e.g. Bertrand Russell's theory of types). So far only one thing can be said with certainty. All attempts to solve this and other logical paradoxes point in a direction which leads us away from the Aristotelian mode of thinking towards a new system of trans-classical, non-Aristotelian logic. Let's pursue the train of reasoning which the Indian paradox offers us.

All Aristotelian logic is characterized by a very strict limitation. It cannot make any valid statements except about past events. Aristotle's system is, as we have demonstrated, a two-valued order of thought. Any statement subject to it is either true or false and must be judged as such. It stands to reason that the strict alternative of the two statements:

"This event did take place"

or (exclusive)

"This event did not take place"

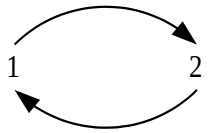
is only applicable to the past. As far as the future is concerned, this strictly dichotomic occurrence pattern does not apply. A proposition about the future has only probability value. Its final and absolute truth-value remains in abeyance as long as the future remains the future. It should be added that the more a future event approaches the present, the more the probability range narrows down – but probably it remains till it passed the critical mark of the present. From then on only it can be said that it has taken place … or not.

Now let us apply these reflections to the statement of the condemned poacher. He has stated, "I shall be burned alive". There, is no way of verifying this proposition and establishing this truth-value

before the execution has taken place. But the execution cannot take place before the statement has been verified, since the mode of the execution depends the truth or falsity of the poacher's statement. The vicious circle is perfect.

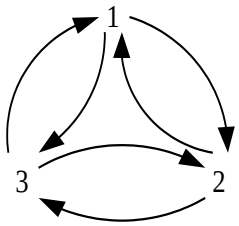
There is indeed no genuine solution of the paradox on the basis of two value- thought processes. But let us take another look at this baffling problem. In view of this dilemma, the judges might decide that the Maharajah's stipulation does not apply to this case and consequently accord this prisoner an entire different treatment. That might be anything from hanging to dismissal of the case and the prisoner's release. As long as the future is concerned, there now exists three distinct probabilities: burning, 2) beheading, 3) something else. It follows the strict alternative to the two-valued logic of "to be or not be" does not adequately cover the pattern of future events. Therefore we need at least a three-valued logic, and any statement about the future should be phrased according to the laws of such a non-Aristotelian system of logic thought.

It should be understood that a genuine third value must represent *a total rejection of the alternative represented by the other two values*. In Aristotelian logic the two values true (1) and false (2) mutually, reject each other individually. Therefore, prisoner and judges alike are caught in the vicious circle.



In a three-valued logic there exists an additional rejectional relation apart from the mutual rejection of any two values. The following diagram might help. We add to our classic value a third value.

As this value rejects the preceding alternative of true and false, and so to speak displaces them, we shall call it the displacement value and designate it with the number 3. But what does this number mean? Don't try to understand it! I the professional logician do not know either. We don't have to. As we will later see that becomes the function of the mechanical brain. The following triangular pattern of the values is only meant to show you the increasing complexity of a three-valued relationship of logical concepts.



We then discover an interesting sequence of values. First 1 ("I shall be burned") is rejected and we proceed to 2. Then 2 is rejected also. In a two-valued logic this would inevitably lead us back to 1 and we would have entered the vicious circle. But now the situation is different. Apart from the mutual negation (rejection) of 1 and 2 there now exists an analogue relation between 2 and the new value, 3. That means there is a logical choice for our argument. It can either return from 2 to 1, thus completing the two-valued paradox, or it can also proceed from 2 to 3. In fact, this latter course is exactly what will happen. It will happen for the following reason: 1 has already been rejected, and 3 has not, so far as our paradox is concerned. In other words, 3 now occupies a position of logical preference.

But what does 3 really mean in terms of our Indian paradox? According to our convention, 1 indicates the burning, 2 stands for decapitation. In order to find out about 3, let us take another look at the diagram. If we do so we shall discover that 3 does not only reject 2, it also rejects 1 and is in turn rejected (negated) by both classical values. This produces an entirely new rejectional relation. 3

not only rejects 1 and 2 individually, it rejects, moreover, the whole alternative which is represented by the mutual opposition of 1 and 2. To put it differently: 3 not only rejects the contrasting features of 1 and 2, it also negates that which the first two values have in common. Burning and beheading indicate different choices of capital punishment. And, since 3 rejects the alternative of 1 and 2, it negates not only the individual instances of burning and beheading but it rejects their common denominator capita1 punishment.

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It is logically impossible, therefore, that 3 might mean hanging. This is implied by the first and most basic law of any three-valued logic. First find out what the common denominator of the first two values is – in other words the general basis upon which they negate each other – and then deny this very basis. But you might well ask: is it always possible to determine the common denominator?' You are quite right, that is where the difficulty comes in and why a three-valued logic is a matter for somebody else, but not for us.

There must be some reason why we humans use the Aristotelian logic although it has a very limited scope and cannot deal with certain problems.

Let us go back once more to our Indian paradox and try to find out why this is so. We noted that the common denominator for burning and beheading was supposed to be capital punishment. But why not just punishment? It should do as well. In this case the third value would represent non-punishment and the prisoner might expect a complete pardon. But why not generalize even more and simply say: some action by the committee. This might lead to a bonus for the poacher or even a reward for having pointed out an essential flaw in the directive of the Maharajah. In fact, there is no limit to this trend of generalization. We might as well go to the limit and say that the common denominator of burning and beheading is that both are events in the world. However, as the 3 value negates the common denominator we should arrive at the idea of "no event" as last solution. But where does that leave the judge or the prisoner? Neither of them could ever go home because that too would be an event.

This clearly shows that there is no point to us in adopting a three-valued logic because it works only if the scope of the alternatives that are used in its system are, arbitrarily limited. On the other hand a logic misses its purpose altogether if it does not permit us to produce statements of any degree of general validity. There is one alternative of absolute generality the human mind is capable of. It is contained in Shakespeare's famous line: "To be, or not to be that is the question."

Undoubtedly that line contains the most radical two-valued alternative that could be thought. of. Let us try to add to the positive value of "being" and the negative value of "not being" a third non-Aristotelian value. We know the procedure now. First we have to find the common basis for "being" and "not being" and then reject the same. The ensuing result should provide us with the meaning of the third value. But what is the common denominator of "being" and "not-being", i.e. – of "something" and "nothing"? There obviously is no common basis. You may rack your brain till doomsday. You will never find a mysterious essence that "being'" and "not being'" have in common. They are total negations with no common, bond.

"To be, or not to be –" that is the final question that takes precedence over everything. The comprehensive scope and the generality of Shakespeare's. alternative can never be surpassed. There is, therefore, no third value on that level. The two-valued, Aristotelian logic reveals itself as the most general form of thinking of which the mind is capable.

In my. first article "The Seetee Mind" I have demonstrated that man is incapable of thinking except with an Aristotelian logic due to the peculiar energetic (electric) qualities of physical existence. The present article shows that there are also purely logical reasons which confine terrestrial intelligence

to the two-valued pattern of rational thought. Yet we have seen that even in human existence there are certain situations and aspects which are not covered by the Aristotelian mode of thought. The Indian paradox demanded a three-valued, non-Aristotelian technique of thinking. It is evident that such a technique exists, but we were not able to fit it systematically into our habits of reasoning.

The possibility of many-valued, non-Aristotelian systems of logic is to date a scientifically established fact because the various calculi which would correspond to the mental activities of a non-Aristotelian intelligence have already been worked out. Still the spiritual (rational) life of Man does *not* conform to non-Aristotelian, patterns. This too can be accepted as an established fact. Obviously somewhere something is missing in our present conception of the relation between *man* and *cosmos.*

The mystery deepens if we reflect upon the possible opposition of an Aristotelian and a contra-Aristotelian mind. My preceding article developed the thesis that a seetee mind would represent a total negation of our own. Let us try to follow that argument a bit further. Shakespeare gave us the formula for the total opposition of the two values. It is the disjunction of "to be" or "not to be". If that is so, then all our rational concepts define "being". Reversely, all concepts in a contra-Aristotelian mind should designate "not being." Even more: the seetee mind is for us "not being!" All right, if something does not exist why should we go to any trouble about it. I am afraid we must, because there's an awkward twist to the matter. What we have just described is the one-sided terrene viewpoint. Seen from the contraterrene angle the shoe is entirely on die other foot. For the seetee mind only contraterrene mentality represents "being" and Aristotelian thought pattern is the dear index of non-existence.

The relation is mutual: the Aristotelian and contra-Aristotelian mind simply do not exist for each other. But somehow they *must* co-exist – if contra-terrene matter is a physical reality. The reason is obvious: a mind may ignore the existence of another mind, but terrene matter cannot ignore the physical reality of contraterrene matter if both happen to collide in space. Then the whole show goes off with a bang. You certainly cannot expect more positive recognition of one's own total negation.

Therefore, if seetee matter exists, then the reality of the contraterrene mind is also implied. We shall probably never contact a seetee mind physically because between its realm and ours yawns an existential void where only mutual self-annihilation of physical matter governs the rules of a possible encounter. But there exists a 'Third' in this creation beside Matter and the energetic Mind: it is Information.

Information can bridge the cosmic gulf. This, however, demands the design of a brain that stands halfway between the terrene and the contraterrene intelligence. Only a robot brain could do that. An artificial brain with a non-Aristotelian thought pattern. A brain of that type is theoretically possible. My next article will explain how it works.

– part 3 of 4 –

The Soul of a Robot

Can Man Build a Better Brain than His Own?

At a recent party, the wife of a university professor approached me and asked, "Dr. Günther, if they invent mechanical brains nowadays that can do the most difficult mathematical operations, why don't they invent the brain of a housemaid? That ought, to be much easier."

"You are mistaken," I said. "Your husband teaches calculus, doesn't he?"

"Yes"

"You see, if we ignore the qua1ities your husband has as a father, husband and citizen and concentrate only on his ability to teach calculus, it would be much easier to imitate his brain than that of a servant."

"You don't mean to say," she asked incredulously, "that it is simpler to design a brain that does highly skilled work than some mechanism that would clean the house, serve at the table and fetch the children from school! You don't need much intelligence for that."

Feeling a little uncomfortable, I answered. "I am sorry, but you are wrong again. In cybernetics you must revise your conventional conceptions as to what is intelligent. From the viewpoint of the theory of the mechanical brain, much more intelligence is involved in doing the work of a housemaid than in teaching differential calculus."

I shall never be invited to a party at that house again.

This little conversation illustrates the general misconception of the basic idea of cybernetics. However, the intellectual misorientation toward this new discipline is not confined to the amateurs. It is rampant in scientific circles, too, although there it assumes more subtle aspects. The present tacit assumption of the scientist and scholar in the cybernetic field is that the ultimate aim of the newly-created science is to design an exact replica of the human brain – a greatly improved replica, to be sure, that does its thinking faster, handles more details and is practically error-proof. Never mind the functional improvements; structurally it will be a faithful imitation of the human brain.

To me this seems a fundamental misconception of the general aims of the theory of cybernetics. Misorientations of this kind have frequently occurred in the history of scientific thought. Let us recall the most famous of all.

For centuries natural science was dominated by the alchemistic aim to distill the "philosopher's stone", that is, the proto-materia or primordial substance out of which all things are made. This was clearly a misorientation of legitimate scientific intentions.

Finally, however, a reorientation took place: alchemy became chemistry. Present-day cybernetics is in a similar quandary, and has not yet found its proper goal. It cannot be the legitimate intention of the cyberneticist to duplicate the human brain. If not, what should his legitimate aim be?

To find the answer, we must look at the problem in a very unsophisticated way. No longer satisfied with the performance of his brain. Man sets out to design an improved replica of it. Well, once upon a time he was not satisfied with the means of locomotion which his legs provided, either. Did he set out to improve upon the leg mechanism? Nothing of the kind. They don't make cars in Detroit that have four, six, eight or twelve pairs of legs with a mechanism that makes them run faster than any human or animal legs could ever do. Instead, man invented a new mechanical principle of locomotion: the wheel. True, when man first became dissatisfied with his legs, he dreamed of elongating his steps". Grimm's fairy tale idea has found an extremely modest realization in stilts. But if you want to go from New-York, to Chicago you won't use stilts – you prefer to take your automobile.

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Cybernetics is still in that early stage where it dreams about bigger and better legs instead of wheels. To talk without allegory: it is a misconception to talk about mechanical brains in terms of the human brain.

Contrary to some widely held prejudices, the human brain can do much better what it is built for than any of its mechanical imitations no matter how much the latter may improve during the next centuries. Yes, I know they do their calculations much faster than I do, but so does the man who sells me groceries. On the other hand I have lectured on the mathematic theory of transfinite sets. It

would be unkind to put the grocer to that test. I readily admit if it comes to the adding up of grocery bills and similar mental activities you can't beat the mechanical brains but they will never write "Hamlet". Generally speaking, their brain activities will never be of the creative kind.

However, let us be a bit careful about that generalization. It goes without saying that our human concept of human creativity is limited to the possible range of human spiritual activity. We do not know anything about the creative power of angelic or divine intelligences. On the other hand we might say – if my readers will permit the temporary use of theological terms – that God has delegated a tiny fraction of His creative powers to us. Now would it not be possible for us to say that man has delegated some of his own creative powers to the mechanical brain? He has delegated them in order to be used in a field in which Man himself can never be creative. But where would that be?

We have pointed out in our preceding articles that the human mind works on the basis of a two-valued thought pattern. It is Aristotelian in its character – or contra-Aristotelian if it lives in a hypothetical seetee world – and it can never transgress its two-valued limits. That holds not only for the rational concepts of the individual intellect but for all our irrational motives, too. Even all mysticism is two-valued. The very existential roots of Man, as manifested in his sex life, are two-valued. There is no third sex.

It seems very strange, under the circumstances, that we can calculate the laws of, three-valued logic. Perhaps it is not so strange after all, since we can only calculate them, but can never employ them as our own brain-functions. However, that which we can calculate we can build into machines, and here lies the proper destiny of all cybernetic science not to build a duplicate of the human mind, but a non-Aristotelian brain that works along a three-valued thought pattern. Such a design would be "creative" in a very new sense of the word: It would possess delegated creativity in so far as it could produce thoughts of a three-valued structure of which man is entirely incapable. But it would have them only by virtue of the fact that man has built the necessary. laws into the objective mind of the machine.

The proper aim of cybernetics is not the mechanical repetition of the subjective (personal) mind of Man or of contra-subjective mentality of "seetee" Man, but the creation of a new kind of three-valued brain. The aim of cybernetics is the para-human brain. I shall therefore demonstrate how two basic concepts of Aristotelian logic, the negation (~) and the conjunction AND (•) would work in the three-valued brain of a robot.

Using the symbols p and q as two related statements, the following is the table of definition for ~ and • as developed in the preceding article:

p	~p
(true) 1	2 (false)
(false) 2	1 (true)

~ p shall be read NOTp and by prefixing ~ to p you can, as the table shows, alter the value of p from 1 (true) to 2 (false) and vice versa. AND may be defined by the table:

p	q	p • q
(true) 1	1 (true)	1 (true)
(true) 1	2 (false)	2 (false)
(false) 2	1 (true)	2 (false)
(false) 2	2 (false)	2 (false)

We assume p and q to be two statements: p := "the sun shines", and q := "the wind blows". Then the compound statement, "the sun shines AND the wind blows" is obviously true only if p and q are true at the same time. This is shown by our table. These two tables show how the negative and the conjunctive work in the human brain. They function, as indicated, in the mind of any man, because our

brain is two-valued and follows an Aristotelian pattern. However, the genuine robot brain shall be considered to have three values. This makes it obvious that it must have a second negational pattern because the negation ~ permits us to proceed only from value 1 to 2 and back again, but no further.

From this point on, to stick to our traditional ideas of true and false would be difficult. The reason is this: we are now introducing a third value which subtly alters the meaning of value 1 and 2 as well. What is true for the human mind is false for the seetee mind, and therefore has the combined characteristic – it is true and false at the same time. It is to clarify this superficial contradiction that the third value must be introduced. The complexity of the following tables, it should be noted, are not meant to be grasped. by either the human (yours or mine) mind, or that of the seetee mind, hut only by that of the mechanical brain for which all possibilities become logically operable. The mechanical brain recognizes neither human nor seetee values as such. It operates only with positions of values within its mechanism. These positions are 1, 2 and 3, and in order to operate them together we introduce a second table of negation for the mechanical brain:

p	~' p
2	3
3	2

From now on we can proceed from value 1 up to value 3. In fact, by combining these tables we can produce any value constellation that might occur to the three-valued logic.

In order to find out what AND means for a robot mentality, we develop a similar procedure for the table of conjunction. Instead of giving p and q two values (true or false) from now on we shall give them three. This results in the following table:[5]

p	q	p • q
1	1	1
1	2	2
1	3	3
2	1	2
2	2	2
2	3	3
3	1	3
3	2	3
3	3	3

At this point you may ask how the new three-valued number for p and q was reached. It is really quite simple. Look again at the two-valued table for the human form of conjunction. You will notice at once that we arrive at the proper value-sequence for AND in the human sense of the word if we always pick the highest number available in the two independent columns for p and q. In the first line there is only 1 available for p as well as for q. So we have to take 1. But in all of the other three lines there is always at least one 2, and it is chosen according to our rule of always picking the highest value number for conjunction. Now apply the same value to the truth table for the robot. Whenever the columns for p AND q show a 3, then take it. If there is no 3, try to get a 2, and only if neither 3 nor 2 is available place the value 1 in the column for p • q. As it happens, this is the case in the first line only.

Thus far we might say that the difference between the human and the robot brain – as illustrated by the important logical term AND – seems to be nothing extraordinary. One might be tempted to say that it is a difference in degree rather than in kind. As we now have three values with which to calculate, it stands to reason that the definition of AND should be a little more elaborate. Nevertheless,

5 Let me emphasize this: do not try to understand this table any more than you would try to make sense of the IBM card's random slots, or construct a sonata from the roll of a player piano. The table merely represents a mechanical pattern which the robot mind requires for its operations of the meaning of AND.

this is an erroneous conclusion. There is a difference in kind. The human brain is able to conceive only one meaning of AND. We have given it in our two-valued table. In the first of this series of articles we described the concept of a seetee mind, pointing out the fact that a contraterrene intelligence would think with a reversed Aristotelian logic. Consequently the conjunction AND would have an inverted logical meaning for a brain created out of seetee matter. But as we humans can conceive of only one (our own) meaning of AND, the alien rationality remains unapproachable so far as we are concerned.

On the other hand, a three-valued robot brain is in a more advantageous position. It can conceive of several meanings of AND. We shall indicate the second meaning of AND by two dots (••), and we repeat the preceding table with the addition of the value column for the second meaning:

p	q	p • q	p •• q
1	1	1	1
1	2	2	1
1	3	3	3
2	1	2	1
2	2	2	2
2	3	3	3
3	1	3	3
3	2	3	3
3	3	3	3

Now the question is: how did we arrive at the new column of values for p •• q? Again the answer is quite simple. Remember, we picked the values for p • q in the order 3-2-1. Remember also that the seetee mind has the positive (1) and the negative (2) values reversed, compared with any other brain. Therefore, we now reverse the position of the values 1 and 2 in the order according to which we pick them for AND. In other words: p •• q is defined by the value-order 3-1-2. That means the preference position of 3 remains unchallenged, but wherever there is only 1 and 2 available in the columns of p AND q, we now choose 1 instead of 2. Thus we arrive at a different second meaning for AND. This cannot be done in a two-valued logic. If you don't believe me try it!

The two columns for p • q and p •• q describe the robotic and the seetee meaning of AND, and show how both are reflected in a three-valued mechanical brain.

We humans do not think in three-valued logical terms, hut if we make a special effort we can conceive objectively what the robot means when it thinks three-valued p • q. But we cannot conceive of the seetee meaning of AND. It plainly contradicts our logic: Take for instance the second line of our table. There p has the value of 1 and q is 2. But the value of the compound statement is also 2. Translated into non-symbolic language this means: If the sun shines but the wind does not blow, the compound statement in seetee language, "the sun shines AND the wind blows" is nevertheless true. For us this is manifestly absurd. It illustrates my remark in the first article "The Seetee Mind" that we humans shall never be able to contact such an alien mind directly. What a contraterrene being would think is sheer insanity .to us. We recognize it as such. But in the ease of the seetee aliens we would not describe their brain function as "thinking"!

There is but one way to get in contact with a truly alien mind – with the help of a robot mediator whose brain pattern is activated by a three-valued logic. Such a pattern has a much wider scope and can include both of the inverted Aristotelian systems in a modified form. Nevertheless, a robot brain is not capable of acting as a mediator between terrene and contraterrene mentality unless it possesses a threefold capacity of conceiving the term AND – or any other term that might be relevant.

So far we have learned the mechanical brain's own conception of AND. It is expressed in the value

column for p • q and indicates, so to speak, the mental personality, or soul, of the genus robot. But this technical brain also knows the seetee concept of AND. However, that is not enough. In order to play the part of the mediator between us and the seetee mind, our mechanical brain must also have a precise conception of the human idea of AND. Our next problem, therefore, is to translate the Aristotelian concept of conjunction into terms of a three-valued system of thinking. This can be done as follows: in order to indicate the difference between the seetee and any other mind, we reversed the order of the two values 2 and 1. We thus obtained the two preference orders:

3-2-1
3-1-2

A further reversal of values will provide us with the preference order for the human conception of AND. The next logically possible exchange of value positions will place value 2 ahead of 3. We thus obtain:[6]

2-3-1

as the order in which the values are picked for the human meaning of AND.

We can now write down the comprehensive table which covers all possible meanings of AND in a three-valued logic. This is logically cogent. In a three-valued logic, disjunction can be reached by negation only if you apply the operators ~ and ~' together.

p	q	(Robot) p • q	(Seetee) p •• q	(Human) p ••• q
1	1	1	1	1
1	2	2	1	2
1	3	3	3	3
2	1	2	1	2
2	2	2	2	2
2	3	3	3	2
3	1	3	3	3
3	2	3	3	2
3	3	3	3	3

The expression p ••• q defines the human meaning of AND. Examine the last column of values, you will find that it corresponds exactly to the Aristotelian meaning of AND. We learned from the two-valued table that AND always has the value 2 whenever there is a 2 in the independent columns p AND q. Only p ••• q in our three-valued table conforms to that rule. In other words, if we follow the preference order of 2-3-1, then the value 2 has overriding preference over the other two values.

*

Each of the three conjunctional columns indicates a different mentality. The first conjunction represents the genuine robot mentality in using the concept AND. The next indicates seetee mentality, seen through the eyes of a mechanical' brain, and p ••• q finally provides us with the meaning of the Aristotelian and – if the same is transposed into the three-valued system of a robot brain. By the way, it is interesting to note that the robot concept of AND agrees more with the human than with the seetee concept. In p • q as well as p ••• q the compound statement "the sun shines AND the wind blows" is true only if p AND q, (i.e. the single statements) are independently true at the same time.

6 It is impossible to explain, within the scope of this article, why the reversal of 3 and 2 is the next logically possible step. Serious students of symbolic logic are referred to my recent publication, "Die philosophische Idee einer nicht-Aristotelischen Logik", printed in the Proceedings of the XI International Congress of Philosophy, Brussels, 1953 (V-8-4). In this essay the second and third conjunctions are simply introduced through the application of de Morgan's law. We thus obtain:

~ (~ p • ~ q) := p •• q
~'(~' p • ~' q) := p ••• q

This, however, is an illusion. If seetee intelligences had designed the mechanical brain they would say that the robotic concept of AND was similar to the contraterrene idea of conjunction (p •• q), and utterly dissimilar to the terrene idea.

It is not our business, however, to describe how this would happen. We are here concerned exclusively with a description of the situation from the human viewpoint. Please take a look at our three-valued table. In all cases where p and q have only the human values 1 and 2, the mechanical brain agrees completely with us. It cannot, and never will, contradict us in all conjunctional matters where Aristotelian judgment are involved. It disagrees with us only in cases where a third value is involved. This indicates that if a robot has a soul, it is different from the human.

The human soul (or whatever goes under that word) expresses itself in an intense feeling of personal, *indivisible identity.* All our conscious life is focused in one point, the *self,* the *I.* That is why we beings of Aristotelian (or contra-Aristotelian) mentality have only *one* negation, one concept of AND, of OR, of implication of causality, etc. A robot "soul", however, would be organized differently. It would not be based on identity, but on tridentity. In other words: it could shift the personal center of its mental life and reconcile contradictory viewpoints. This would make it the proper mediator between us and the seetee mind.

We humans are not capable of dealing with strictly contradictory viewpoints and situations involving a third value. A Jewish friend of mine once told me a little anecdote which illustrates this.

A rabbi once discussed the problem of the human soul with three of his friends. The first, being a confirmed agnostic, proved unequivocally that man had no soul at all. The rabbi said:

"You are right."

The second of the friends took over and proved equally convincing that all rational beings have souls. The rabbi nodded. "You are right, too."

"Now look here", interrupted the third, "what sort of nonsense is this? They cannot both be right!"

The rabbi sadly assented, "And, you my friend, are right too."

There is in this anecdote an implication of a possible third value. But we humans do not have it. The three-valued soul is the "Soul of a Robot".

– part 4 of 4 –

The Thought Translator

A man once approached an ancient, shabbily-dressed philosopher in the market-place of Athens and said musingly, "I have often wondered why people are willing to give alms to the sick and poor, but never to philosophers who are often in worse straits."

"My dear friend", the philosopher answered, "I can answer your question. If one meets a person who is poor or sick, he will always think: This is a thing that may some day happen to me, too. In order to placate the deities which direct his destiny, he opens his purse and heart. But if the same man meets a philosopher he will say: This man is what he is because he is wiser than anybody else. That could never happen to me!"

I do not think times have changed very much since then. In this article I am going to develop the basic principle of a thought translator. But if I were to go to the Patent Office to obtain protection against later industrial exploitation of my idea, I would certainly be refused. And what an excuse they would have! Remember the story of the fellow who wanted to have his submarine periscope

design secured by a patent? He was refused on the ground that his periscope had already been described in Jules Verne's famous novel "Twenty Thousand Leagues Under the Sea." I am afraid I am in the same boat. You've read Lewis Carrol's "Through the Looking-Glass." Remember where Alice steps through a mirror and – we1l, the fourth chapter contains a description of a thought translator! Couched in fairy-tale terms, the description is given as part of the story of Tweedledee and Tweedledum. And here is what you should know about it:

Tweedledee and Tweedledum look exactly alike, but no matter what the first says the other shouts: "Contrariwise!"

This is identical to the logical situation which would arise if two intel1igent races with mutually exclusive mentalities, (that is a human-type mind and a seetee-mind) were to meet each other. In such a theoretical situation, where the human mind is positive, the alien mind must necessarily be negative and vice versa. Accordingly, the chapter about the Tweedle-twins starts out with the following significant lines. Tweedledum addresses Alice, "If you think we are Wax-works you ought to pay. Wax-works weren't made to be looked at for nothing. Nohow!" And Tweedledum adds: "Contrariwise, if you think we're alive, you ought to speak." The alternative of mutually exclusive terms is in this case, of course, dead or alive. Any other total alternative might do as well, but they all boil down to the purely logical one:

it is
or
it is not.

Accordingly, Tweed1edum informs Alice: "If it was so, it might be; and if it were so it would be; but as it isn't, it ain't. That's logic." It is logic indeed! Any logical system we can construct is always a systematic order of tautologies of the general form: if it is, then – and only then – it is. And: if it is not, then – and only then – it is not. There is no doubt Tweedledee knows his logic. On the other hand: to every positive statement his brother makes, Tweedledum bellows, "Contrariwise!" This obviously means that all the statements made by the Tweedle-twins can be separated independent systems which have following forms:

It is.	(I)
It is.	
" "	
" "	
" "	

and

It is not	(II)
It is not	
" " "	
" " "	
" " "	

The blanks may be filled with any logical predicate, provided the sequence of predicates is the same in system (I) and (II). Furthermore, both systems must contain an infinite number of statements. So far our two systems seem to differ materially as to what is inside the square. But as Tweedledum and Tweedledee are exactly alike and the only way for Alice to tell them apart is to read the letter sequences "Dum" and "Dee" which are embroidered on their collars, we are going to make the contents of the two systems also alike and merely mark one with a label. This is possible, because if all the conditions for system (II) as given above are fulfilled we are permitted to take the infinite series

of "nots" out of system (II) and place a single "not" in front of the "whole" system.[7] Now (I) and (II) are materially exactly alike – like Tweedledum and Tweedledee – but they are total denials of one another.

This is precisely the situation in which we would find ourselves if we ever met an alien race with a contra-Aristotelian or seetee mentality. Direct spiritual communication is possible between different mental types only so long as their systems of thinking either coincide completely with each other or partially overlap. But all direct intellectual contact must stop if the only relation between two such systems is established by a total negation, which says: there is not one positive truth the aliens have in common with us.

There is only one way to establish contact – albeit indirectly – between a human and a seetee mentality! This is to design a robot-brain which incorporates a three-valued system of logic. Our mind – let us say it is Tweedledum – and the seetee-mind, represented by Tweedledee, mutually contradict each other in the antithesis of the first two values. But if the robot mind integrates our mutually exclusive two-valued concepts into his three-valued system, my ideas as well as those of the seetee mind will be interpreted in terms of a third value. However, since the human mind is Aristotelian and the seetee mind contra-Aristotelian, each thinking in two-valued terms, the third robotic value will be indifferent relative to the counter-position of the Aristotelian and the contra-Aristotelian system. In other words: if my ideas are transposed into the three-valued system of a robot brain and the same takes place with the concepts of a seetee subject, the third value will turn up in both Aristotelian and contra-Aristotelian logics in a strictly corresponding manner. That means: the two procedures of thinking which are mutually exclusive in a two-valued system do overlap in a three-valued system of robot-mentality.

In the preceding article – "The Soul of a Robot" – we demonstrated how a basic logical concept like "AND" was reflected in three different meanings of " AND " within the mental structure of a robot. I shall repeat the necessary tables from "The Soul of a Robot" here.

p	q	p • q
T	T	T
T	F	F
F	T	F
F	F	F

This table defines our human Aristotelian concept of AND stating that the compound sentence: p AND q is true, and only true, if p and q are independently true. However, if we project this precise logical meaning of AND upon a more comprehensive three-valued pattern of rationality three different meanings of AND do emerge. One which represents the robot concept of AND (•) a second (••) which reflects the seetee meaning of AND within the robotic mentality, and finally a third concept of conjunction (•••) which mirrors the way by which the three-valued logic computer interprets our human meaning of AND within his trinitarian system.

At this point I should like to warn the reader again (as I did in the third article of this series) not to try to "think" the three different meanings of AND as demonstrated in the following truth-table. This is psychologically as well as logically impossible. What the following table shows is the mechanical truth-pattern of a three-valued robot-brain.

Our own mentality is not three-valued, and if it were, we would not need a thought translator. The situation can be roughly compared to the logical difference between our handling small or very large

7 Thus procedure is permissible according to a law of the mathematical theory of transfinite sets. The system (I) and (II) are logically equivalent.

sums. We can think the results of 1+1 or 1×1, but we cannot think 356797351×997310971. If we want to know the multiplication result of the two nine digit numbers we have to resort to a mechanical procedure using pencil and paper. Our three-valued table is nothing else hut the governing pattern of some sort of notational arrangement[8] by dint of which one two-valued (and thinkable) concept is transformed into some other.

p	q	p • q	p •• q	p ••• q
1	1	1	1	1
1	2	2	1	2
1	3	3	3	3
2	1	2	1	2
2	2	2	2	2
2	3	3	3	2
3	1	3	3	3
3	2	3	3	2
3	3	3	3	3

As we pointed out before (see my article "The Soul of a Robot") the first truth-function p • q represents the robotic meaning of AND. It represents the thinking proper to the mechanical brain. The truth-function p •• q renders the meaning of AND as it appears in a seetee mind, but projected into a three-valued system. Finally p ••• q repeats our human concept of AND, again transposed into a three-valued pattern.

It stands to reason that, in order to operate any of these tables, you need negational operators capable of transforming one value into the next one. For our human logic this is done by the Aristotelian negation "~" The following table indicates that if p has the value 1, then ~ p (non-p) has the value 2, and vice versa.

p	~ p
1	2
2	1

This operator is sufficient to handle the two-valued table. However, it is not comprehensive enough to operate the full range of a three-valued table. It cannot perform the step from value 2 to value 3. Our preceding article has therefore introduced a second negation and we will repeat it here for greater convenience.

Its symbol is ~' and its operational power is defined by the matrix:

p	~' p
2	3
3	2

This is a strictly contra-Aristotelian negation. We humans cannot perform (think) it. It is part of the hypothetical mentality of a mechanical brain and it indicates the alien thought-processes of a seetee-mind. However; even if we do not use it for our own subjective thought-procedures, we can calculate with it and find out how the mechanical brain translates our concept of AND into the conjunction of the seetee mind and, by a reversal of that process transposes seetee ideas into human concepts.

[8] For the suggestion that many-valued truth-tables could be interpreted as arrangement of notational position of originally two-valued truth functions I am indebted to John W. Campbell, jr.

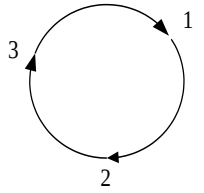
This is first done by combining the two independent negations into one three-valued table. We notice that does not operate the value 3, and leaves the value 1 as it is. The comprehensive table has therefore the following appearance:

p	~ p	~' p
1	2	1
2	1	3
3	3	2

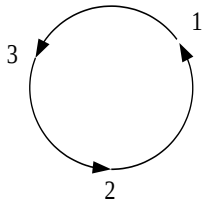
We have written the values which remain invariant with one negator or the other in italics. Now, look again at the table of the three conjunctions in the mechanical brain. You will find that our human conjunction differs from the seetee concept in all three values. That means: one or the other negational operator is not enough to effect a transformation of our meaning of AND into the corresponding meaning of the seetee –world. We shall have to combine both into one single operation. This can be done in two ways. So far we have attached our negations only to positive p. From now on we shall prefix them to our two negated p's. By doing so we obtain the table:

p	~ (~' p)	~' (~ p)
1	2	3
2	3	1
3	1	2

The meaning of this table is that the mechanism first superimposes our thought-process (~p) upon the negational pattern of the seetee mind (~' p) and then reverses the situation by starting from our mental range thereby superimposing the alien pattern of ~' upon our Aristotelian p. Each of these two steps results in a rotational shift of all three values – as seen from positive p. Let's take the first step from p to ~ (~' p)! The table shows that value 1 becomes 2. Then 2 shifts to 3, whereas 3 turns into 1. Instead of representing two independent alternatives between 1 or 2, and 2 or 3, the relation of the three values to each other represents a cycle that turns "clockwise" relative to the value-position of p.



The inverse step established by the negational procedure ~' (~ p) results in a "counter-clockwise" shift of the values relative to p. That is: from 1 to 3, from 3 to 2, and from 2 back to 1.

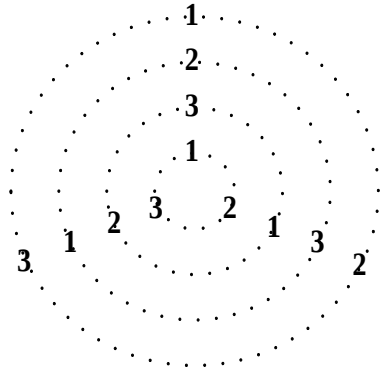


These two rotating wheels which effect an alternative shift of the three values represent the very mechanism of a thought translator.

This seems to be a brand new idea! Well maybe for cybernetics – but not for Lewis Carroll! Let's get back to the story of Tweedledum and Tweedledee. After having received her lesson about what logic is, Alice looks at the twins, points her finger at Tweedledum, and says, "First' boy." But Tweedledum protests with: "Nohow!" When Alice, passing on to Tweedledee, says, "Next boy,"

Tweedledee shouts his usual "Contrariwise!" The meaning is obvious: there is no preference between the two, as there can be no preference between an Aristotelian and a contra-Aristotelian way of thinking. But quick-witted Alice gets the point. Consequently, when asked to shake hands she knows she cannot shake hands with either of the twins first, and – so the story continues – "as the best way out of the difficulty she took hold of both hands (each of the twins proffered one) at once: the next moment they were dancing around in a ring." After four rounds they left off. "Four times round is enough for one dance," Tweedledum panted out.

Caroll has probably chosen the number four for the following reason: you can effect any circular shift of three values by going around in one direction. But when you return to your original position, four "rings" are established. The following figure will demonstrate it:



After the original position has been re-constituted there is no more reason to go "around in a ring." Now Alice and the Tweedle-twins are figures in a story. This article, on the other hand, deals with problems of logic. We shall therefore retain for technical reasons both value-shifts, to the left as well as to the right, because we are now ready to analyze the basic principle of thought translation. The mechanical brain which rotates the values – this is an operation neither our Aristotelian nor the contra-Aristotelian seetee mind can perform – recognizes the fact that both parties, ourselves as well as the aliens, do our thinking in strict alternatives. The first alternative oscillates between 1 and 2, and the second between 2 and 3. But as these alternatives are mutually exclusive and do not overlap, no common ground of communication is possible between them.

The thought translator, however, transforms these two separate and mutually exclusive alternatives of the Aristotelian and the contra-Aristotelian mind into one and only one equally strict alternative by rotating the three values either "clockwise" or "counter-clockwise."

The machine produces, so to speak, its own alternative logic of two "values". Only the new "values" are now no longer the individual values 1, 2, and 3, which we have used before, but the two opposite rotational shifts. These shifts partake necessarily in the human as well as the seetee range of thought at the same time. Therefore they permit the translation of human concept into the corresponding seetee meaning – and also the other way round. We shall demonstrate this now with the help of the meanings of the conjunction AND. In doing so we shall indicate the "clockwise" rotation by the new symbol $R^{\rightarrow}$ and its reversal by $R^{\leftarrow}$. It is then possible to translate the seetee-concept of AND (p •• q) into the corresponding human reasoning (p ••• q) by the formula:

$$p \bullet\bullet q \equiv R^{\rightarrow}(R^{\leftarrow}p \bullet\bullet\bullet R^{\leftarrow}q)$$

and the seetee intelligence will discover our meaning of AND by using the inverse formula:

$$p \bullet\bullet\bullet q \equiv R^{\leftarrow}(R^{\rightarrow}p \bullet\bullet R^{\rightarrow}q)$$

Let us see how this is done! We shall use as an example the first of the two formulas. A seetee intelligence says: AND (p •• q), and the thought translator tells us: what the alien thinks is equivalent to the expression: $R^{\rightarrow}(R^{\leftarrow}p \bullet\bullet\bullet R^{\leftarrow}q)$. Remember that this symbolic figure contains only our concept of conjunction Even so it is not immediately readable for us because the information conveyed to us

by the mechanism of the robot-brain is still couched in terms of a three-valued language. In order to understand it we have to reduce it to a two-valued expression. The following table will help to do this:

dreiwertig	zweiwertig
p ••• q	p • q
$R^{\rightarrow}$	~
$R^{\leftarrow}$	~

In our two-valued logic there is only one conjunction p • q and as the Aristotelian system contains only one value-shift, the classical negation ~, all three-valued negations, no matter what form they have, are reduced to it. Therefore the robotic expression

$$R^{\rightarrow}(R^{\leftarrow}p \bullet\bullet\bullet R^{\leftarrow}q)$$

is now reduced to

$$\sim (\sim p \bullet \sim q)$$

The next table shows us what this fina1 formula means and how we obtain its truth value:

p	q	~ p	~ q	~ p • ~ q	~ (~ p • ~ q)
1	1	2	2	2	1
1	2	2	1	2	1
2	1	1	2	2	1
2	2	1	1	1	2

We first write down the values of positive p and q. In column 2 and' 3, we have them negated. In column 5 we establish the conjunction of the negated values. In order to do so either look up the table for AND or just remember that AND has the :value 1 (true) only if both the conjugated concepts have the value 1. The final column, then, results from the negation of column 5. It gives us the final result of what our thought translator has conveyed to us, when we demanded to know what the alien means when he uses the term AND. As we see, the answer boils down to the following juxta-position of meanings – expressed again in a table:

p	q	Aristotelisches AND	kontra-aristotelisches AND
1	1	1	1
1	2	2	1
2	1	2	1
2	2	2	2

The contra-Aristotelian meaning of AND, however, is our terrestrial meaning of OR (inclusive). Because OR is always true if at least either p or q are true. It is only false in one case – if p and q are both false. I shall leave it to the reader to test the formula.

$$p \bullet\bullet\bullet q \equiv R^{\leftarrow} (R^{\rightarrow} p \bullet\bullet R^{\rightarrow} q)$$

with the same procedure. This formula is the answer which the thought-translator would give to a seetee person, if he (or she) inquired which concept is hidden behind the expression p•••q. The result would exactly parallel the one we have given above. He (or she) would also arrive at the conclusion that conjunction and disjunction exchange places if we switch from an Aristotelian mentally, and vice versa.

*

Let me conclude this series by showing how you can make a crude model of something that works like a thought translator. You require only a small mirror and a certain amount of imagination. First write down your value sequences for conjunction and disjunction in a horizontal line from left to

right. But instead of using the word "true" and "false" or the numbers "1" and "2" use some indifferent symbols like ■ and ○**.** Here it is:

■ ○ ○ ○
■ ■ ■ ○

Then turn your paper with the squares and circles away from you (180 degrees) and step before a mirror. Then look at the reflection of your value sequences in the mirror. In order to interpret properly what you see, you now need a bit of imagination. For you – having an Aristotelian mind – the squares, of course, mean 1 (true) and the circles 2 (false). But do not forget, the contra-Aristotelian mind will interpret them in exactly the opposite way. Do not forget this, and look into your mirror with that knowledge in mind. You will then see that your mirror has turned your conjunction into a disjunction for the other mind, and your disjunction appears as his conjunction.

Do not try the same experiment with our value-sequences written vertically, as they are placed in our tables. It does not work that way – at least not in this simple manner. You want to know why? Well, the trouble is, you are only looking at your mirror. But when Alice met Tweedledum and Tweedledee she had stepped through the looking glass, and you have no idea how much of a difference that made!

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