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Logic as seen by logician

In order to explain what contemporary logic is, it is good to reach for its history – the present state of the discipline being explained genetically, through an analysis of its development, through the past dealings which have shaped it.

The starting point for today's logic has been made by Aristotelian *Analytics*. Here, logic begins, yet what it is meant to be and what it has become was decided by events prior to this – the rise of philosophy and rhetoric.

Philosophy, striving to express the most general truths about the "construction" of the world, at the moment when there appeared Heraclitean variablism, as a specific answer to the question about *arché*, which found its expression in acceptance of the internally contradictory utterance (**B49a** *we come into the same river, and we do not come out of it, we are and we are not*), came to face the question: how is truth assigned? Mechanisms that govern assigning truthfulness to the sentence constitute the nucleus of the debate Heraclit-Parmenides. The answer that was accepted maintains that an appropriate description of reality does not allow co-truthfulness of a sentence and its negation, or in other words: the logical evaluation is of a functional character (that is a sentence can be assigned one and only logical value), or still in other words: the law of identity is in force.

Yet, rhetoric – the art of convincing – which was being formed simultaneously, raises the question that is of outstanding importance: how to justify truthfulness? How to convince others about the truth? This question is of particular importance, if one is a philosopher – not only an expert in the truth, but also its propagator. However, Gorgias and Protagoras clearly pointed to the limitations which the well-known means of justifying are subject to, and Democritus (Aristotle; Metaphysics Volume Γ 1009b: *Democritus said* […] *that the truth is not known to us*); he claimed that the truth will not allow itself to be proved.

The question about the non-undermining justification of truthfulness was relevant, primarily, for Socrates – the philosopher who wanted to teach his fellow citizens about the virtue by perceiving, in the cultivation of it, the only help for Athens at the moment when it

was heading for a definitive fall. And Socrates did find a way out: the truth allows itself to be established in a strictly undermining manner, when it concerns bonds between words. Plato built universal ontology upon this idea and – at the same time – proposed that the very science should be a science concerning the relations between ideas, ideas whose reflection/shadow are found in the accessible through senses world. From this perspective the key to a reliable scientific justification are regularities in functioning of language.

Aristotle's work on rhetoric opens with the following short statement: *Rhetoric is an anti-verse of dialectics*. Nothing more and nothing less can be said. If rhetoric is an art of investing an utterance with a persuasive form, securing effectiveness thanks to a psychologically and aesthetically proper selection of words, as well as to the manner of their setting, that is, technically speaking – thanks to tropes and figures – dialectics (that is – to us – logic), is an art of establishing such formal bonds between premises and conclusions derived from them and guaranteeing the preservation of truth in the course of such a reasoning. In the act of convincing – without dialectics – we can merely come to deal with seduction by means of words, to wit we cannot establish a regular science.

From this perspective, logic is a theory of reliable convincing, a theory of constitutive action for the sake of science, and the one that is useful in almost every act of interpersonal communication.

As a domain of science, though, logic must legitimize its recommendations; it needs to prove that practical indications for argument users are trustworthy, that truthfulness-related bonds between premises and the conclusion do occur and, what is more, they do so each time, independent of the matter of reasoning as long as the proper form is given to them. Aristotle, in a true sense, begins to build logic, since – firstly – he considers forms of sentences from which reasonings are built that are significant for Plato's vision of science, and – secondly – he points out to a scheme of formal construction of such reasonings, which consists in transition to a direct relation between terms on the basis of the bond between these terms and a certain third term; after all it organizes uniformly built schemes of appropriate reasonings to form a system of reciprocal reductions. This is a paradigm of creation of the syntactic version of the logical theory incessantly binding since that time; and the effect – syllogistics – has remained a living and inspiring accomplishment until today.

The Achilles' heel of Aristotle's construction was the lack of explanation of links between the recommended models of reasoning and the mechanism of asserting truthfulness.

Basing the system on "perfect procedures" created for the role of axioms through making reference to the *emipirium* confirming their obvious argumentative effectiveness could only be of the temporary character. It was necessary to theoretically justify that each time – in the case of the important procedure – the truthfulness of premises guarantees truthfulness of the conclusion, a justification based on delineation of the logical value of categorical sentences; the justification carried out in the same manner as that in which Aristotle explained the reasons for which procedures were incorrect, procedures from outside the system, do not yield conclusions worthy of absolute, logical, trust. In short: it was necessary to present semantics for syllogistics.

The task was challenging and it offered an object of research to logicians for several centuries. Following the Aristotelian solution of the question of rejection to date: making reference directly to reality, has proved to be taking the wrong path. Such reference was only too obvious, as a matter of fact: after all the truth is *adequatio orationis et rei*, after all rejection of uncertain procedures has been achieved while moving along this path, at the same time confirming the usefulness of it for logical considerations. That logicians indeed followed the path is easy to understand if one interprets, in the right way, the so-called dispute over *universalia* – the foundation of the medieval rebirth of philosophy grown out of the question that is basic to logical semantics: what happens in the world of objects that a categorical sentence which tells us about these objects, is true? But, as I have already said, the taking of the path was misleading, as falsifying a general rule can be realized with the use of a single example that can be found in the surrounding world. On the other hand, the confirmation of the rule that is generally valid, can never be obtained in a conclusive manner with the use of any finished (yet not exhausted) list of examples conforming to this principle.

The idea that proved successful and constituting semantics adequate to the tasks posed to it was the creation of the image of functioning of scope-related relations in the graphic form, one consisting in pictures facilitating visualization by means of circles, sections or squares – dependences deciding about logical evaluation of a categorical sentence. Venn's diagrams offer the final shape of the geometrical version of semantics for syllogistics (as a matter of fact not the only one); let us remember about Leibnitz's arithmetical semantics and those of Professor Słupecki – I believe a person still dear to people from Opole.

There is still one more subject that is very significant for the contemporary perception of logic, one that is impossible to overlook: although it appeared in syllogistics to a marginal

degree, I am going to make reference to it just through syllogistics. In the tradition of debating about errors, which can be committed while constructing syllogism, there is present *quaternio terminorum*, consisting in the occurrence of one and the same word/phrase in a variety of meanings. Formally, because of the form of utterance, we come to deal with the logically appropriate structure, however the semantic relationships which condition the effectiveness of reasoning are violated and – hence – the justification is faulty. This draws attention to the following fact: semantic relationships – of key importance for the proper course of procedures of reasoning – are not given once and for ever; neither are they given *a priori*, but are created by language users. If this is so, there appears one more theoretical problem of a considerable importance posed to logic to be investigated – the problem of regularity in functioning of semantic establishments made by users of a language.

Thus, there have been formed three fields of research proper to logic: syntactics – examination of language structures that guarantee transfer of the truth in the course of transformations of the form of utterance; semantics – examination of the mechanism of attributing the truth to utterances of the given form; pragmatics – examination of regularities in forming semantic bonds.

Still, the process of a development of logical investigations does not undermine the starting characteristics of logic; on the contrary – it does strengthen it: logic was, is and most probably will remain a theory of reliable argumentation. It turned out only how naïve the representation which accompanied (to some extent) its development was, that is that the task posed to logic would be simple to carry out. And how naïve the opinion is, so clearly expressed by Kant, that logic is a closed, completed science, merely subjected to 'fine tuning' of details and simplified in presentations of it. This opinion seems to be sometimes shared by the very logicians themselves up to a moment when a crisis undermines the trust in logic and explicitly shows that resting on oars has been premature.

Up to now there have been at least two major crises affecting logic: in the 17th century, it turned out that it was impossible to make progress in the development of theory of logic without building adequate formal semantics, and it was impossible to guarantee methodological usefulness of logic without broadening the forms of utterance so as they would include structures of marginal value to date. The overcoming of the crisis was possible thanks to the formation of algebra of logic, followed by calculus of predicates. In the 20th century, another crisis was brought about by a sudden critique on the part of the humanities,

which was launched at the moment when the latter experienced restrictions of logical analyses to date – analyses that sufficed as regards their usefulness to the exact sciences, yet too 'stiff' when encountering the natural language. The question *sui generis* of semantic instability of the colloquial language became the key problem, and the way to solve the problems that were revealed was developing the so-called pragmatic logic (that is logical pragmatics).

But, let me return to the basic truth concerning logic: logic was, is and will be the theory of reliable argumentation. Why, then, in the colloquial sense, this is not obvious to the degree it should be? It is because in the course of the development of the discipline, which I briefly outlined, there happened many things diverting attention from the basic task for logic: it was already in the time of Renaissance when Peter Ramus broke up the liaisons between logic and rhetoric, which at once – when the tradition of *trivium* was still alive – seemed to be an ordering of the research fields of particular sciences, yet fairly soon it led to withering of rhetoric, to its distortion and to its being pushed towards usage of flowery empty words, and which cut logic off the reflexion on language with the whole of its inspiring richness, which is of life-sustaining importance to logic. Let us remember that at the moment when, on the threshold of the 17th century, logic was attacked, playing the role of theory of scientific proof, the attackers recruited themselves from mathematicians and natural scientists-physicists who badly needed reliable mathematics in the same way as they needed the fresh air. Focussing research on a precisely defined section, delineated by the then pending problems of science, yielded positive aspects in two ways: introduction of symbolic language as a tool of formulating theories of logic and also restriction of the analysis to a narrow fragment of language, that is the one in which theorems of mathematics are uttered.

The average receiver of such theories is influenced by the similarity of the manner of expressing oneself and the genesis of this *façon de parler* in such an overwhelming way that as far as a popular feeling is concerned, logic is treated – paradoxically – as a fragment of mathematics. There is still one more reason for this positioning of logic: introduction, in the role of a tool for doing formal semantics (which contemporary logic cannot do without) of objects 'delivered' by mathematics: algebras and topologies. I said a moment ago, talking about observers-non-logicians, that they are too often convinced about the 'mathematical' nature of logic. Logicians themselves are partially responsible for this state of things: they offer *ex abrupt* a formal framework even in elementary introductions addressed to complete laymen. An advanced lecture, on the other hand, exposes as a rule technical complications, be

it hypothetical-deduction systems or algebraic, topological or relational semantics. An expert's fascination with problems that are of key importance to developed and specialized logical theories is understandable – this is their research area, a mine of problems that they want to face with. My own didactic contacts with students of philosophy make me conclude (please accept this as a confession of a man of practice, not as a strict official statement) that even among persons, who – due to their interest – should be resistant to this belief, it is spreading on a wide scale: some are convinced that they are forced to study things that philosophers should not know, since this does not become philosophers; some others – zealously embrace 'signology', indifferent to very area a theory of which they are dealing with in fact. Attempts to pull both the former and the latter out of this stereotype are sorrowfully inefficient.

The stock of language structures, with which we come to deal with in mathematical utterances, is relatively scanty, and the stylistic differentiations of the shape of uttering a concrete structure are practically non-existing. The symbolic language which suffices to build a theory of reliable justification within mathematics, is too poor so as to successfully extend it over the whole richness of language in which we express ourselves in the colloquial way, even if one can take into consideration only – disciplined at last – expressing opinions by scientists dealing in less exact branches of science. At the present stage of its development, at least as it is perceived by a casual external observer, only weakly interested in the subject, logic is associated with mathematics still for one more following reason: in its spectacular achievements it is a theory of mathematical proof, all in all – the theory of reliable argumentation anyway – with the provision that it is only for the use of highly specialized kind. An objection raised with reference to the domination of logic perceived in this way is natural, and movements like *informal logic* or *New Rhetoric* are a sound waking up of logicians from their dream while resting on oars.

Fortunately, getting to know the new challenges has already begun. In Poland, undoubtedly, the pioneer of these studies, one who has deserved great praise not only for carrying out concrete studies, but also for promotion of the whole current of pragmatic logic is the person, whose lecture was delivered here directly preceding mine today, I mean Professor Marek Tokarz.

Asking about priorities for developing new studies we need to, first, clearly answer the following question: What did mathematical logic (by which I understand the logic shaped

until the mid-19th century for the needs of mathematics) lack in that was decisive for the appearance of the crisis which we want to overcome? It seems that two issues are of key importance: the first – already mentioned before – deficiencies of formal analysis of structures that were present in the colloquial language in a real way and which organize the shapes of utterances, and the other: the static character of semantic liaisons with which we have come to deal is a very Platonian-like world of mathematical objects, a world of coherent truth. The second case is more significant: after all complaints about logic primarily concentrate on not taking into account the truthfulness mechanisms that are really present in reasonings carried out everyday, in which all plagues that undermine the justifiability of making references to laws of logic, and whose common name is ambiguity.

The traditional logic used to know the phenomenon of ambiguity and proposed ways out, means of eliminating errors, to which usage of expressions of natural language leads in processes of reasoning in a manner void of reflexion. For a long time, simple – yet effective at the same time – directives have recommended the following: avoid occasional treatment, define blurred terms, order words in a way such that the sense of the whole is obvious. As a matter of fact, there is nothing to eliminate and very little to add here. Why, then, is such excellent advice, and simultaneously so effective, postponed? It is because behind their filling up there hides departure from the real to an improved language, a basically different language – although this does not show up at first sight – a language different from this used to express the reasoning presented for analysis.

The challenge consists in servicing reasonings, in which semantic relationships are not subject to stiffening, but have managed to preserve the whole of their flexibility proper to the natural language. Can logic meet this challenge? This will not be easy, but – optimistically – I claim that – to some extent – I will. What speaks in favour of it? Simply the fact that the process of communication is realized incessantly and effectively in the given language; that – applying our common sense – we agree to accept certain reasonings for which logic – the one to date – did not provide legitimization, and we reject the others in an equally intuitive manner. What is more, one can point to regularities of structural character which occur in these procedures.

The suggestive entries informing of the already undertaken studies, ones that have already proved successful, are implicatures and presuppositions.

And, just by way of digression connected with treatment of the above-mentioned studies as flagship research project, the so-called *informal logic*: there is nothing that we could call informal logic and there cannot be anything like that – logic consists in a theoretical analysis of the bond between the form of language and logical evaluation. If we cannot find a proper expression for this form, if we have difficulty 'isolating' it from crude language material, then let us not say that we practice informal logic, but that we are at the preparatory stage of constructing a logical theory and that we wrestle with the construction of the language, in which the form will find its adequate expression. Initial observations, however inspiring they could be, have the character of *heuresis*, out of which a logical theory will grow; still, this is certainly not the target point to reach for logic-science.

And here is one more digression: logicians cannot disown the symbolic language as a tool or means drawn from mathematics to make precise semantic intuitions – let those who count on some future logic doing without signs abandon such illusions. Logic will not allow itself to be pushed away from its methodological achievements!

What is then logic seen through the eyes of a logician? It still remains a theory of reliable justification, but – at the same time – one having a clear-cut scope of studies in prominent areas of the treble nature: syntactic, semantic and pragmatic; a theory having at its disposal a formed methodology with virtues acknowledged by research successes, a theory facing up – at present – to new, fascinating and difficult intellectual challenges. To those who want to say that my discussion of the whole of the questions co-forming the core of the discipline is too superficial, I want to reply: logic is also a theory which, already now, strikes with multiplicity and complicacy of its research areas. Already now, only a few who I will not hesitate to call people of genius-like stature, are capable of participating in all areas of research carried out in a creative manner, or of controlling its richness even if solely in an erudite-like way.

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What can linguists expect from logic? Questions relating to the reality of functioning of the language as it is in its everyday usage – since developing logical pragmatics must base on reliable recognition of possibly the richest resources of systematically accumulated linguistic material. And where to look for such data if not with linguists?

And what can computer scientists expect? What they have been making use of so far, the output of formal analysis of language conducted by logicians, that is the manner of

looking at language which allows its 'purely mechanical' transforming, which is brought down to manipulation with the sign, that this output will keep enlarging, and – at the same time – will be getting broader by such aspects of functioning of natural language that will allow a skillfully programmed machine to come closer – in the process of communication – to the Türing ideal of being unable to distinguish between the computer and the human being.