Valentin Vandyshev

LOGIC

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CONTENS

FROM EDITOR AND AUTHOR

The history of learning and teaching logic counts thousand years. The first studies about forms and ways of reasoning about different things and phenomena appeared in the countries of the Ancient East, in China and India. On the European territory the basis of the modern logic are the studies, which were initiated by sophists in the V century B.C. and created mainly in the IV century B.C. by the thinkers of the Megara School and Aristotle from Stagier (384–322 B.C.). Aristotle was the one to detach the logical speech forms from its content, detached the logical from rhetorical.

The scholastics in the XII-XIII century, Raymond Lullus (1235–1315), Leonardo da Vinci, Francis Bacon, Galileo, Thomas Hobbes, Pierre Gassendi, Rene Descartes and his students, Gottfried Leibniz, who attached to the logic its modern form, John Stuart Mill and a long row of philosophers till the XIX century inclusive, were guided in their conception of logic as the instrument of cognition by different considerations and preferences.

The possibility of cogitative process formalization, which was noticed by R. Lullus and G. Leibniz in due time, gave rise to the new vision of the world, became the powerful factor of the science mathematization and life computerization. But this is a special field of logic which is interesting itself.

This textbook is a traditional structure of logic course, which has become usual for the European spiritual culture throughout many centuries, beginning with the Scholasticism. This fact distinguishes it from overwhelming majority of existing logic textbooks, authors of which always complicate the subject, making it beyond the strength of modern students' perception. I suppose that our textbook will make a serious competition to the existing logic textbooks and rather serious help to our students. This textbook provides the needed minimum of logical knowledge, promotes the logical thinking basics formation, and considering a lot of illustrations, which it contains, develops the cultural potential of the competent expert.

The important positive feature of the textbook is the presence of deeply and graphically developed system of questions, tasks and exercises, which lets practically feel the whole power of logical thinking and, right away, check your abilities and the level of your knowledge in the sphere of classical logic.

Prof. V.N.Vandyshev

THE SUBJECT AND TASKS OF LOGIC

The aim of human cognition consists in the comprehension of truth, delicate and complex matter. Logic is a science, which demonstrates how the thinking must be performed to reach the truth; to what rules the thinking must submit to reach the truth. The thinking, with the help of which the truth is reached, should be called the right thinking. So, **logic may be defined as the science about the right thinking laws or the science about the laws, to which the right thinking submits.**

Since logic investigates thinking laws, its subject turns out to be close to the psychology subject. So we must look at the thinking as at the well-known process, the laws of which we investigate. And this is the point of view of psychology. On the other hand, we may look at the thinking as at the means of reaching the truth. And that, to which laws the thinking must submit to reach the truth, is the subject of logic.

So, the difference between psychology and logic in respect to the thinking process may be expressed more definitely. Psychology examines all possible kinds of thinking activities objectively: discourse of genius, ravings of a madman, thinking of a child, psychical activity of an animal, because the very process of thinking is important for psychologist. Logic examines the conditions, under which the thought may be correct. In this respect logic approaches grammar, that states the rules, to which the speech must submit to be correct.

The peculiarity of logic subject is the particular investigation of different facts. There are facts, the truth of which is seen *directly*. When we say: "I am hungry", "I hear music", "I see this object moving" etc., the facts, that are expressed here, must be considered as directly cognizable or directly obvious, because they don't need any proofs, their truth is obvious. When I sit on the green grass, I will hardly agree with the one who states that this grass is purple.

All facts that are performed in our absence (phenomena of past and future in particular) may be cognizable only indirectly. When I see

that it rains – it is a fact of indirect cognition. And that it was raining at night is a fact of *indirect* cognition, because I get to know about it thanks to another fact, that is that under the windows the asphalt is wet and there are puddles outside. The facts of direct cognition or just direct cognition is the result of inference, conclusion.

Indirect knowledge is proved, is made convincing, obvious with the help of direct knowledge. This process is called *the proof*. The proof consists our attempt to turn the unobvious points into the directly obvious or entirely obvious points or facts.

There are definite rules, which show how to distinguish the right inference from the wrong ones. These rules are stated by logic, because its task is to show the laws, which the inference must follow to be right. If we know these rules, we can define whether they are observed in one or another inference process. The task of logic is also to warn against possible errors in the proof.

Logic is a great persecutor of the dark and complex thinking; it clears away the fog, which hides from us our ignorance and makes us think that we understand the subject when we do not understand it. Also the difference between mathematical, physical, historical and other sciences may become clear only when examine the difference of cognition methods from the logical point of view.

The creator of logic as a science is fairly considered to be Aristotle (384–322 BC). It was his logic that had the predominant meaning in ancient times and in the Middle Ages, in the epoch of scholastic philosophy. The pupils of R. Descartes in 1662 published the logic, known as the logic Port Royal, which defined its *formal* trend. The founder of the *inductive* logic is considered to be the English philosopher Francis Bacon (1561–1626), and later his ideas were developed by John Stuart Mill (1806–1873).

We consider any point to be true materially when it corresponds to the facts or things. We consider one or another conclusion to be true formally when they are concluded with the proof out of other points, i.e. when the way of combination of thoughts is right, though the conclusion itself may not correspond to the facts at all.

The formal logic studies mainly the sections of logic, where the formal truth criterion may be applied. The inductive logic, as opposed to the formal, mostly develops the sections, where the empirical and material criterion is applied.

Topic 1. THE STUDY ABOUT THE NOTION

Notions and terms. To begin with, we should examine different notion classes, though in the number of logical works philosophers begin their exposition with the examination of terms, names and nominations. They act on the premise that in logic one should interpret not just the notions, that offer well-known mental structure, but one must interpret them, because they find expression in language, speech. Since we express the notions with the help of words, nominations and so on, to their mind, in logic it is more reasonable to talk not about notions, but about nominations, names or terms.

Indeed, there is no essential difference between these two considerations. Each notion in our thinking is fixed, gains firmness, definiteness thanks to one or another word, name, term. When in logic we use term, we always mean the term, which is connected with a known word. So it doesn't matter whether we will talk about names or terms, or whether we will talk just about notions.

Individual and general notions. Notions may be individual (single) and general. Individual notions are the notions that concern the single, individual objects. Here individual notions coincide with ideas about single things, for instance: "the Ukrainian Ambassador in France", "the highest mountain in America", "the author of "Dead Souls", "this book". Proper names belong to single notions, for instance: "Hoverla", "Newton", "Rome". The notions that belong to the group or the class of objects or phenomena, which have a known resemblance with each other, are called general or class notions. These are, for instance, the notions "plant", "animal", "gas", "engine", "act", "movement", "beauty", "anger", "feeling" etc.

General, collective and disjunctive notions. Single and general notions sometimes may be used in a particular sense, so called collective. If I say the sentence: "Forest serves for the preservation of moisture",

“forest” in this sentence is one out of the great number of similar objects. Here the notion “forest” is used in general meaning. But “forest” may represent as a whole, consisting of homogeneous units. In this case, the notion “forest”, or the term “forest”, becomes collective, or generalized.

Collective notion means the whole, group, consisting of homogeneous units. For instance, notions “regiment”, “crowd”, “library”, “forest”, “parliament”, “constellation”, “inflorescence”, “class” are collective, if we mean that they serve for designation of the whole, consisting of homogeneous units.

But the same notions become general, when we conceive them as certain representatives of the known class. For instance, “regiment”, “crowd” are general notions, when it goes about “regiments” and “crowds”; in this case the objects, marked by these notions are examined as units, which belong to the known class of similar objects. If I use the notions “The museum of T.G Shevchenko.”, “English parliament” etc., I use collective notions, because they express the known whole, which consist of homogeneous units. If I say “Ukrainian libraries, museums, universities” etc., these are general notions, because I speak about libraries, museums and universities as about known class of similar objects.

So, collective notions are the special form of individual notions.

General notions and collective are very often confused, that’s why it is important to draw your attention to the differences between them. Everything that we state about collective notion, concerns the known whole, consisting of single units, but this statement may not be applied to the objects, which are the part of this whole and may not be taken separately. Vice-versa, everything that we state about general notion may be applied to any object, which this notion concerns. One thinks about collective notion as the whole, consisting of homogeneous units; about general notion as the class, which consists of similar objects. Saying that “the parliament issued the law about general compulsory military service”, we want to say, the known whole, consisting of known

units, has issued the known law, but it cannot be said about each Member of Parliament, because certain members of parliament may support the previous order of military serving. In this case, the notion "parliament" is used in collective sense. But, using the expression "the legislative power belongs to the parliament", we use the notion "parliament" in general sense, because the mentioned expression is true concerning all parliaments.

Sometimes we may use either notion in such a way, that our statements will be true concerning each certain unit, which is the part of either group of objects. Such usage of notions we call the usage in disjunctive sense. When we use any notion in collective sense, we relate our statement to the group, which is examined in whole; if we use it in disjunctive sense, we affirm anything about each member of the group separately. Saying "the whole fleet was killed during the storm", we use the notion "the whole" in collective sense, because we talk about the fleet as a whole. All ships may not be killed, but the fleet as the known whole stops existing. If we use the expression "all workers are tired", the word "all" there is used in disjunctive sense, because we mean the fatigue of each worker separately.

Abstract and concrete notions. Abstract notions serve to define the qualities and characteristics, states, and activities of objects. They define qualities that are examined on their own account, without objects. When we use abstract terms, we do not state at all that corresponding qualities or characteristics, states of objects exist somewhere in the certain space or in the certain point of time, but vice-versa, we think about them without objects, and that's why without certain space and time. For instance, abstract notions are "heaviness", "volume", "form", "colour", "intensity", "hardness", "pleasantness", "weight", "and humanity". Because "heaviness" is not something, that exists at the present moment: it exists everywhere, where there are heavy things. We call these notions abstract, because qualities or characteristics, which are designated by

them, may be thought about without those objects, to which they belong: we can abstract away, distract ourselves from all things.

We may also sometimes call abstract those notions of such objects, which we can't apprehend as a known certain object, for instance, "universe", "stellar system", "mankind" etc.

Concrete are the notions of things, objects, persons, facts, events, states, mind, if we examine them as if they have certain existence, for instance: "square", "flame", "house", "battle" etc. Abstract notion is got out of concrete, when we single out by means of analysis any quality or characteristics of the thing, for instance, whiteness out of whiting. On the other hand, we may look at concrete notion as at the synthesis of abstractly thinkable qualities. For instance, the notion "stone" is the synthesis of such qualities as "heaviness", "roughness", "hardness" etc.

Let's take notice that adjectives are always concrete terms, not abstract; using the adjective "white", we always think about the thing; we think about the quality or characteristic when we use the noun "whiteness". Sometimes in speech abstract and concrete terms are used in pairs. For instance, the abstract notion "whiteness" corresponds to the concrete term "white", the abstract notion "strictness" corresponds to the concrete term "strict", "squareness" – to the term "square", "humaneness" – "human".

Positive and negative terms. Positive terms are characterized by the fact that they serve for the designation of presence of one or another quality. For instance, using the terms "beautiful", "divisible", "final", we want to know, that there are available qualities in objects, which are designated by these words; corresponding negative terms "ugly", "indivisible", "endless" will designate that mentioned facts are absent in objects. Other negative terms: "timeless", "pretersensual", "abnormal", "unconcerned", "meaningless".

Relative and absolute notions. Finally there are relative and absolute notions. What does absolute mean? To our mind, absolute is something that is not related to anything else, that is not dependant on

anything else; relative is something that is connected with something else. Absolute notion is the notion which in its meaning doesn't contain any relation to anything else, it doesn't make us think about any other things, except the ones, which it defines. For instance, the notion "house" is absolute. Thinking about the house, we can think about nothing else. Relative notion is the notion, which, except the object it defines, assumes also the existence of another object. For instance, the notion "parents" necessarily assumes the existence of children: one cannot think about parents without thinking about children at the same time. If we talk about any person, that he is strict, we can limit our attention to this person only; but if we talk about him as a friend, we must also think about one person, who is in friendship relation to him. Other examples: "companion", "partner", "similar", "equal", "close", "king–subjects", "cause–action", "north–south". Each notion in these pairs is called relative to another notion.

Questions for revision:

1. How should the terms-notions correlation be interpreted?
2. What notions are general, and what are individual?
3. About what notions do we say that they are used in collective sense, and about what – in disjunctive sense?
4. What is the difference between collective and general terms?
5. What notions are called abstract, and what – concrete?
6. What terms are called positive, and what – negative?
7. What notions are relative, and what – absolute?

LOGIC EXERCISES

Examples:

Let's give the logical characteristic of terms: "museum", "debtor", "ignorance", "virtuous", "war", "N.V. Gogol", "nationality", "equal".

1. Museum. The term has two meanings: a) building, b) collection of interesting objects. In the first meaning this term is general, concrete, positive, absolute. In the second meaning – general, collective, concrete, positive, absolute.
2. Debtor – general, concrete, positive, relative.
3. Ignorance – general, abstract, negative, absolute.
4. Virtuous – general, positive, absolute.
5. War – general, concrete, absolute.
6. N.V. Gogol – single, positive, concrete, absolute.
7. Nationality – general, positive, abstract, absolute.
8. Equal – general, positive, concrete, relative.

Tasks:

1. Give two examples of single and general terms.
2. Give two examples of collective terms.
3. Show the usage of a term in disjunctive sense with the help of example.
4. Give two examples of abstract, concrete, negative, absolute and relative terms.
5. Give two concrete terms and form two abstract out of them.
6. Give logical characteristic of terms: “crowd”, “colour”, “unhealthy”, “ant”, “the highest man in the world”, “non-Christian”, “organism”, “equality”, “chemist”, “black”, “honest”, “boredom”, “desire”.
7. Which of the following terms are abstract: “ignoble”, “house”, “hourly”, “rudeness”, “individuality”, “truth”, “faithfulness”, “yellow”, “yellowness”, “childhood”, “book”, “blue”, “intension”, “mind”, “reasonableness”. In what sense is the term “all” used in the following examples:

a) Everyone was discharged.

b) Everyone administered an oath.

c) All criminals were caught.

d) All the people rose in rebellion.

e) All the class was punished.

f) All the class took part in the celebrations.

Topic 2. THE CONTENT AND THE VOLUME OF NOTIONS

The features of notions. Feature is something with the help of which we distinguish one idea or notion from another. For instance, the features of gold are "metal", "precious", "having certain specific gravity" etc. These are the things with the help of which gold is distinguished from other things, from nonmetals, from non-precious metals etc.

Not all the features are of equal worth. Every notion has many different features, but thinking about it, first of all, we chiefly think only about known features. These features are primary, around which other features are grouped. First features are called essential, or main, and others – secondary. The main features are such features, without which we cannot think about the known notion and which recount the nature of object. For instance, essential for rhomb is that it is quadrangle with parallel and equal sides, etc.; inessential for the notion rhomb is that feature, that it has one or another size of sides or size of angles.

According to Aristotle, the notion features may be divided into 5 classes:

1. ***Genetic feature.*** If we state that chemistry is a science, the science will be a genetic feature for the notion "chemistry"; among other features of the notion "chemistry", there is a feature "science"; this feature distinguishes chemistry from everything that is not science. Genus or genetic feature is a class notion, into which we include another notion, which we examine.
2. ***Specific difference.*** Stating, that chemistry is a science, which studies the structure of substance, we will add the feature – "studying the structure of substance", which serves for designation the difference of this science from others. The feature, that serves for singling the notion out of the number of alike notions, is called specific difference (differentia specifica). Let's take the notions "Ukrainian sailor", "French sailor", "English sailor". In this case "Ukrainian", "French", "English" are specific features, and they let single the sailor of one nation out of sailors of other nations.

3. ***Species.*** If we add specific difference to genetic feature, we will get species. For instance, "the building for the store of weapon" = arsenal; "the building for the storage of grain" = warehouse. In this case "building" is genus, "for the store of weapon" is specific difference; adding the specific difference to the genus results in the species "arsenal". Adding the specific difference "for storage of grain" to the notion "building" results in the species "warehouse". Species may be a feature, because it can be ascribed to the notion. For instance, "this science is chemistry".

4. ***Proprium*** – is such a feature that is characteristic to all objects of the given class, which is not present in the number of main features, but can be taken out of them. For instance, the main feature of human is his "reasonableness". From this feature results his ability to speak. The latter one is proprium. The main feature of a triangle is a rectilinear plane figure with tree sides. As for the feature of triangle that the sum of his angles makes two straight lines, that is its proprium, because it results from his main features. We don't think about this feature, when we think about triangle, that's why it is taken out.

5. ***Accidens*** – is such a feature that cannot be taken out of the main feature, though it can be characteristic to all objects of the given class. For instance, black colour of the raven is accidens. If the black colour was taken out of its main features, it could have been called proprium, but it is not, because we do not know, why ravens are black. This means, that it is accidens.

Accidens are divided into two groups: accidens inseparabile and accinens separabile. The latter are the features that are characteristic of some objects of this or that class, but not of all, and the first are characteristic of all objects of the given class. For instance, the black colour of raven is accidens inseparabile. The black colour of hair for a human is accidens separabile, because there are people, who don't have black hair colour. In respect of separate individuals accidens may also be inseparabile and separabile. Separible – are the features, which at one time are obvious, and at another time are not. For instance, V.A. Yushchenko is the president of Ukraine. In some time he may not be a president. This feature is separabile.

"G.S. Skovoroda was born in 1722". In this sentence the feature "was born in 1722" – inseparabile.

The content and the volume of notions. The notions may be examined from the point of view of content and volume.

The content of notion is what is thought in the notion. For instance, in the notion "sugar" the following features are thought: sweet, white, rough, having weight, etc.; these features in total make the content of the notion "sugar".

The content of the notion is the sum of his features, and that's why we can apportion every notion on the number of its own features. The content of notion changes, depending on the accepted point of view, on the knowledge level, qualification, age, gender, etc.. So, in the notion "sugar", a chemist thinks about one content and a first former – about another.

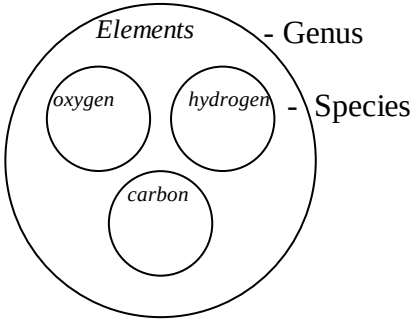


Fig. 1

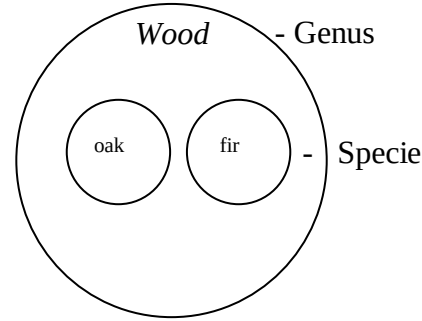


Fig. 2

The volume of notion is something that is thought with the help of notion, i.e. volume notion is the sum of those classes, groups, genders, species, etc., to which the given notion can be applied. For instance, the volume of the notion "animal": bird, fish, insect, human, etc.; the volume of the notion "element": oxygen, hydrogen, carbon, nitrogen, etc., and the volume of the notion "quadrangle": square, rectangle, rhomb, trapezium.

Thus, the difference between the volume of the notion and the content of the notion comes to the following: the volume of the notion means that totality of objects, to which the given notion must

be applied, and the content means those features, which are ascribed to one or another notion.

For the clearer idea of the volume of notions and the relation of volumes, there is a special approach, which is called *logical symbolism*.

On the ***fig. 1*** the large circle symbolizes the notion "element", and smaller circles, which are in it, symbolize notions, which are included into its volume. If we depict some circle inside another circle, we symbolize that the volume of one notion is included in the volume of another. From the ***fig. 2*** it is obvious, that the notion "wood" includes in its volume notions "oak", "fir", etc. Separate points in the circle "fir" symbolize individual or single firs.

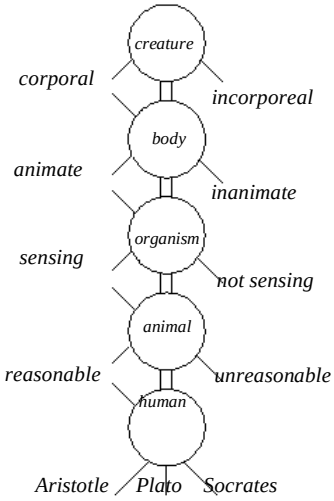


Fig. 3

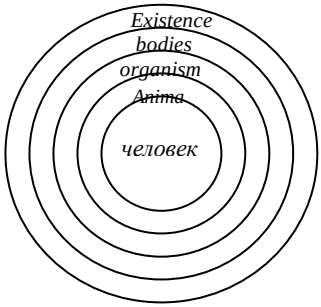


Fig. 3a

The notion with larger volume is called genus with respect to the notion with smaller volume, which is included into its volume. The notion with smaller volume in this case is called species. Notions with larger volume may be called wider or more general notions.

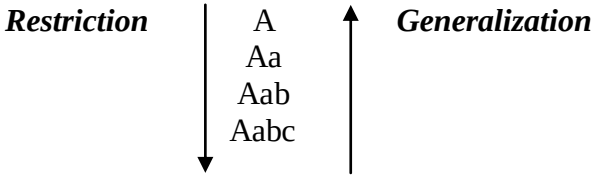
One should bear in mind that every species may become genus. For instance, the notion "palm tree" belongs to the notion "tree", as species to genus, but in its turn, it belongs as genus to its species – "coconut tree", "fig tree" etc.. In total, more general notion is genus for less general notion; more general notion is a gender notion for less general notion, less general itself becomes genus for even less general, etc., until we come to such a notion, which in its volume can't contain any other species, and may be subdivided only into separate individuals.

Let's remember about the effort of Greek philosopher *Porphyry* (233-304) with the help of scheme to simplify the understanding between notions, which embrace each other, i.e. notions, one of which is included into the volume of another. This scheme is "Porphyry's tree". Into the notion "existence", i.e. everything that exists, is included the notion "corporal existence" and "incorporeal existence". The body includes in its volume an animate body, or organism, and inanimate body. The notion "organism" includes in its volume sensing and not sensing organisms (plants). Sensing organisms include in its volume reasonable and unreasonable creatures, etc. ***(fig. 3).***

Existence is the highest genus, which cannot be species for another genus. Such genus is called summum genus; human is the lowest species. Notions with smaller volume are not included into its volume, only separate individuals. Such notion is called infima species (the lowest species). The nearest highest class (or genus) of one or another species is called proximum genus (the nearest genus). Relations between much wider and narrow notions may be depicted in another way, placing the circles, which serve for the designation of notions with smaller volume, inside the circles, which serve for designation of notions with larger volume ***(fig. 3a).***

Restriction and generalization. The process of formation of less general notions out from more general is called restriction (determinatio). For the formation of the less general notion we must add some features to the more general, thanks to what the notion is being understood (determinatur). So, to get the less general notion "palm tree" out of the notion "tree", we need to add special features of the palm tree to the features of the tree: form of leaves, straightness of the stem etc.. The opposite process of formation of the more general notion out of the less general, when, vice-versa, some features of the given notion are deprived, is called generalization (generalisatio).

Genus is formed from species with the help of generalization, and, vice-versa, species are formed from genera with the help of restriction. These processes we may depict with the help of the following scheme:



Let's suppose, that we begin with the notion **A** (science). With the help of specific difference **a**, we can form from it the species **Aa** (mathematics); and if we add the feature **b** (the definition of spatial relations) to this species, we will get geometry **Aab**. When we add the feature **c** (the definition of spatial relations on the plane), we will get planimetry **Aabc**.

The opposite process – receiving of the more general notions by means of taking away the separate features – is called generalization. Both processes may be depicted with the help of the following scheme, where the arrows show the digression from the more general notions to the less general or, vice-versa, ascension from the less general to the more general notions.

The relation between the volume and the content of the notion. For understanding the relation between the volume and the content of the notion, let's use an example. The volume of the notion "human" is more extensive than, for instance, the volume of

the notion “black man”. Using the notion “human”, we think about all people, who live in all five parts of the world, including Africa. Using the notion “black man”, we think only about the people who live in Africa. As for the content of these notions, we should say right the opposite: the content of the notion “black man” is more extensive than the content of the notion “human”. Speaking about the black man, we may find in it all features of the notion “human” plus some special features, as: black skin colour, curly hair, flat nose, thick lips etc.

Thus, as the content of the notion becomes more extensive, its volume becomes smaller, and vice-versa.

Questions for revision:

1. What are the features of notion?
2. Which features of notions do we distinguish?
3. What is genetic feature?
4. What is specific difference?
5. What is species?
6. What is proprium?
7. What is accidens?
8. What is the content of the notion?
9. What is the volume of the notion?
10. What is generalization?
11. What is restriction?
12. What relation does exist between the volume and the content of the notion?

LOGIC EXERCISES

Examples:

1. Whales are mammals.

In this sentence, the predicate is genus with respect to the subject.

2. Some people are poets.

In this sentence, the predicate is a species of the subject.

3. The pentagon is a figure with five sides.

Here the predicate is a combination of the genus and specific

difference.

4. Man can study logic.

Here the predicate is proprium, because it results from the features of reasonableness.

5. Swans are white.

The predicate is accidens, and besides it is separabile, because it doesn't necessarily belong to the whole class.

6. Shakespeare was born in Stratford.

Here the predicate is accidens inseparabile of the individual Shakespeare.

7. Wise man has a severe attitude to his duties.

The predicate is proprium, because it results from the main features of the wise man.

8. Balfur is the first minister.

The predicate is accidens separabile.

Tasks:

1. Formulate the law of relation between the volume and the content of the notion. Show the rightness of this law on the following series of notions:

a) "iron", "metal", "element", 'substance"
b) "substance", "organized matter", "animal", "human"
c) "book", "print book", "lexicon", "Latin lexicon".

2. Arrange the following terms in lines, so that each term with larger volume stood higher than the notion with smaller notion: "Napoleon", "creature", "personality", "Catholic", "emperor", "animal", "sovereign".
3. Analyze the following sentences:

a) Proper fraction is such a fraction, in which a numerator is less than a denominator (show what in this sentence is genus and what is species).
b) English are smart sportsmen (to what features does the notion "sportsmen" belong?).
c) All black people are curly-haired (what feature is "curly-haired"?).
d) Caesar was a great commander.
e) Tiger is a predatory animal.

4. Indicate genus, specific difference, proprium and accidens of the notions "gold", "house".

Topic 3. LOGICAL CATEGORIES AND RELATIONS BETWEEN NOTIONS

Categories. There is not a single object that would be completely different from other ones; they are alike in any relation: it can always be related to the class of other objects, all objects can be related to the classes common for other objects.

There are classes that consist of a little number of objects, but also there are classes, that include a great number of ones, and it's just because of their greatest likeness. These classes of things in our thinking are expressed as known notions. Such notions that serve for denotation of the most common objects' qualities were named categories by Aristotle. For Aristotle the categories are possible predicates of any single object, i.e. such concepts that can be expressed in regard to one or another single object or a class of objects.

Here are these categories:

1. Substance (substantia)
2. Quantity (quantitas)
3. Quality (qualitas)
4. Relation (relation)
5. Place (ubi)
6. Time (quando)
7. Condition (situs)
8. Possession (habitus)
9. Action (action)
10. Passive (passio)

According to Aristotle these ten categories envelop everything that we can think. If we wish to say something common for these or those things, we can not say about them anything but that they are essence or substance, or that they denote quality, relation, place etc. Other points of view, except included in categories, don't exist. So, we can say that the categories are the most common classes of everything we can think.

In new philosophy philosophers distinguish **thing, quality and relation** as the most common classes of thinking. Everything we think is a thing or substance, quality or relation.

By things we mean something that possesses more or less permanent form. For instance, stone, wood or liquid in the glass etc.

possess such permanency. The piece of stone today possesses the same form as yesterday: we imagine that it will possess such permanency further.

We imagine things that possess known features or qualities, or that act in a known way, or that are under known conditions. For instance, the fact that a piece of iron has its known heaviness is its quality or feature. If the piece of iron is heated, that is its condition, if the piece of iron is melting or moving, so it is a known process, condition. We consider quality, action, condition belong to known thing, to their known possessor.

But at the same time we consider them as the elements of thing: we consider iron something possessing known heaviness, solidity, ability to become heated, to move etc. We will call quality, action, condition by one common name – thing's qualities.

Logical relations between notions:

1. Notions subordination (subordinatio notionum) exists when one notion is related to other one, as types to their genus, when one notion volume includes another notion. Take the notion "wood" ***A*** and "birch" ***B*** as example.

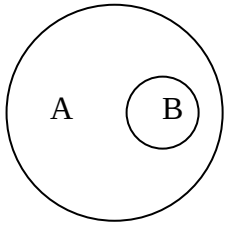


Fig. 4

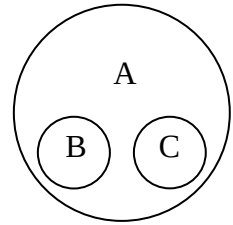


Fig. 5

The last notion is included into the first one. The symbol of subordination is on ***fig. 4***. Some other examples: "spiritual activity", "gustatory sense", "person", "mathematics".

2. Notions coordination (coordination notionum)

We deal with it when the volume of one and the same notion includes two or more equally subordinate notions. These subordinate notions are coordinate. For example, "courage" ***B***, "temperance" ***C***, "virtue" ***A***. Both first notions are included in the volume of the first one ***(fig. 5).***

3. Equipollent notions (notions aequipollentes)

Take two notions to clarify this one: "the English" and "the first sailors". When we say "the English", we mean English people. When we say "the first sailors" we also mean English people; consequently the volume of these two notions is the same. Now reveal the meaning of these two notions. By the notion "the English" we mean the known political system, the known territory, the known culture and so on, by the notion "the first sailors" we mean – the known art of ships building and their control, the known development of sea economy, the multiplicity of marine etc., consequently the meaning of these notions is different. If we have two notions with different meanings, but with the same volume, then these notions are equipollent.

Other examples: "Christian – christened", "organic – mortal", "the greatest writer – the author of "Dead Souls". Equipollent notions are the separated circles, flowing together, like the volumes of indicated notions; the difference of meanings is symbolized by different letters in the same circle ***(fig.6).***

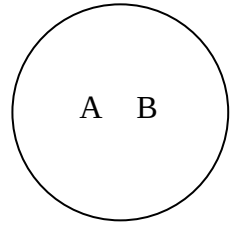


Fig. 6

4. Contrary and opposite notions.

One should pay special attention to these two different classes of notions that are similar by their outer features, but different by meanings at the same time, and think well about their difference as while operating them it's easy to make a mistake. If we take any notion's volume and classify the types it concerns according to similarity degree in the way that after each type we will take another one, the least different from it, as a result we will get the line of these meanings – notions, where the first and the last ones will differ much from each other. These two notions, the first and the last, in the number of types are contrary and opposite. For example, let's classify according to the way mentioned before the

types of the notion “colour”. Its volume includes different hues of possible colours: red, green, black, white, grey etc.

If we using the way mentioned before put the types into the line according to their similarity degree, we can get the next number: white, whitish, light grey, grey, dark grey, blackish, black.

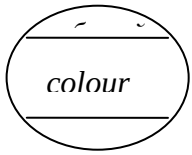


Fig. 7

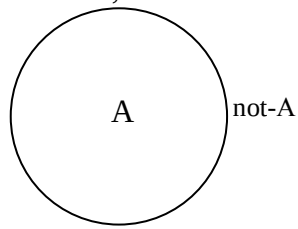


Fig. 8

As we see – the greatest difference here is between the notions “white” and “black”; they are contrary and opposite notions. So, the notions that are the parts of the same notion but that differ greatly are contrary (contrariae). The scheme: in the circle, that symbolizes the volume of a notion, two separate parts are divided by the line, and are situated in front of each other ***(fig.7)***. Some other examples: “kind”–“angry”, “high”–“low”, “beautiful”–“ugly”, “loud”–“quiet”, “deep”–“shallow”. One should admit that not all the notions have the contrary ones. For example, the notion “blue” doesn’t have a contrary notion.

If we have some notion ***A*** and another notion ***B***, which is not ***A*** as we know, then they are in contradiction (contradictoriae). For example, the notions “white” and “not white” are contrary. So two terms, one of which is formed by adding particle “not”, are contrary. Symbolically the relations between the contrary notions are expressed in a particular way ***(fig.8).*** A notion ***A*** is symbolized by the circle and a notion ***B***, which is not ***A*** and can be put anywhere, but not in the circle, not in its volume; this second notion by its qualities is called negative or indefinite (notio negativa seu indefinita).

If we take two opposite and contrary notions: “white”–“black” (contrary), “white”–“not white” (opposite) then we can visually make sure that the difference between these two notions is great: whereas the second word in the first example (black) has quite a definite meaning, the second word in the second example

(not white) doesn't have such a definite meaning; his meaning is indefinite i.e. by the word "not white" we can mean green, red, blue and even big, nice etc.

5. Crossing notions (notiones inter se convenientes). When there are two notions with different meanings, but their volumes partially coincide, these two notions are called crossing. Take the notions ***A*** "writers" and ***B*** "scientists". The volume of the notion "writers" includes a part of the volume of the notion "scientists", while some writers are scientists, and from the other side the notion "scientists" contains a part of the volume of the notion "writers", while some scientists are writers. It can be described with the ***fig. 9***.

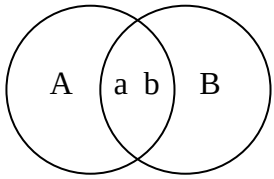


Fig. 9

While that part of the volume of the notion "writers" that consists of scientists, and the part of the volume of the notion "scientists" that consists of writers are logically equal, then the can be symbolically shown as the parts of two circles which overlapping coincide. That's why the scheme of two crossing notions can shown by two crossing circles, which symbolize the volumes of meanings of those two notions; and their crossing point is coinciding, logically equal parts of those volumes. Another example is rectangular figures and parallelograms, while some rectangular figures are parallelograms and some parallelograms are rectangular figures.

6. Incomparable notions (notiones disparatae). Let's take two notions: "soul" and "triangle". They don't have any common generic meaning, they are not coordinate. They don't have any mediate, connecting element, on the basis of which they could be compared. Such two notions are in the state of incomparableness. To compare these two notions we need something that would unite these notions – it's the third notion in which volume they can be included. This third notion is called – tertium comparationis.

One should admit that it's the question of absence of the nearest generic notion. If, for example, we take such two notions as "ship" and "inkpot" notwithstanding their difference they have

something in common (they are things), but there is not any nearest generic notion, in which volume they could be included.

Questions for revision:

1. What is the category? Which categories were picked out by Aristotle?
2. What does notions' coordination and subordination mean?
3. Which notions are called equipollent?
4. What are contrary and opposite notions?
5. Which notions are crossing and which ones are incomparable?
6. What do we need to compare the notions?

Topic 4. NOTION DEFINITION

The aim of definition. When we pronounce any word correspond to the known notion, and want to make it clear for everyone, we need to expose its meaning of the notion, i.e. of the mentioned word, but since the meaning of the notion is the totality of its qualities, then exposing of the notion's meaning can be an enumeration of its qualities. For example, the notion ***A*** possesses the qualities ***a, b, c, d***. If we enumerate these qualities we will explain the meaning of the notion ***A***.

It should be admitted that not all the notions can be defined. The notions can be different by their meanings since a contents of one can be smaller and of another one it can be bigger. A notion with complex contents, i.e. have many qualities, can be defined. But there are notions that have such a simple contents that can not be defined because, as it was mentioned, one needs to expose the meaning to define it. When a contents of a notion can not be exposed it can not be defined either. Such notions are called simple. For example, the notion "crimson colour" can not be defined: one should see this colour to know what it means. All definitions we can give in this case would be logically wrong. However, to define what the tone of the known height mean is uselessly; it is understood and learnt by direct accepting of this tone. Here belong the notions as "equality", "identity", "heaviness", "gravity", "consciousness" etc. Some individual notions can not be defined in the same way, because while defining them one should enumerate the line of an endless number of qualities. For example, "that diamond".

So, to define this or that notion means to enumerate its qualities. But sometimes it turns out to be a difficult task, while the number of qualities of this or that notion can be quite great, that's why to enumerate all the qualities if it would be impossible. For example, if defining the notion "rectangle" we say that a rectangle is a geometric figure, flat, framed by direct lines, quadrilateral, with right angles etc., then this definition would be right but inconvenient to enumerate the number of qualities. As a result

another way of definition was accepted, that aims to avoid the enumeration of qualities. It consists in the following.

Let's give the definition of a rectangle. For this aim we will use the notion "parallelogram". When we use the term "parallelogram" by it we mean either a rectangle, or a rhomb, or a square. Knowing that we won't say that "a rectangle is a geometric figure, flat, framed by direct lines, quadrilateral, with right angles" and so on, we will simply say that "a rectangle is a parallelogram with right angles". It is clear that everybody by a parallelogram means a geometric figure, framed by four direct lines and parallel lines. Adding that all angles are right we finally finish its definition, distinguishing a rectangle from a rhomb and a square, which are parallelograms. So defining the notion "rectangle" we defined its type (parallelogram) and joint its type distinctions (four right angles), distinguishing it from other types of the same gender, i.e. from a rhomb and a square. Following the same rule we will say that "a rhomb is a parallelogram with equal sides", and "a square is a parallelogram with equal sides and right angles".

So a definition lies in pointing out a gender of a notion, adding its type distinction. In logics to define it the following formulation is used: "Definitio fit per genus et differentiam specificam", i.e. a definition is made by a gender and a type distinction. If we need to define any notion we express our definition by means of thought that has a subject and a predicate. The subject of this thought is called defined (definiendum); the predicate is called defining (definiens). These terms are important because thanks to them we can point out those rules, observing which we get a correct definition. There are four of such rules.

1. The notion has to be proportionate, i.e. the volumes of the defined and the defining notions must be identical, the same. When this rule is not followed then a notion is unequal and disproportionate. Then the definition becomes either wider or narrower, just when the volume of the defining one becomes too wide or too narrow in comparison to the defined one. Take the notion of a horse. If we say that "a horse is a domestic animal", so this definition will be too wide. Here the defining volume will be

wider than the defined one (the volume of the notion "domestic animal" contains other animal besides horses: cows, dogs, sheep). Concerning this definition we can say that it doesn't contains an essential quality of the notion. When in definition the essential qualities of the notion are dropped then it seems too wide, as in just mentioned example.

Let's take a definition which is not perfect in opposite direction. If we say that "a triangle is a flat, rectilinear figure with three equal sides", then this definition would be too narrow. The volume of the defining notion in it is less then the one of the defined. So, the volume of the defining notion contains only equilateral triangles, but the volume of the defined notion contains either equilateral or inequilateral ones.

2. The definition must not make a circle. Observing this rule demands that *a defined notion should not be defined by means of a notion that becomes clear itself only by means of a defined one.* Take the definition "rotation is a revolving on an axis". Such definition of the notion "rotation" by means of the notion "axis" makes a circle, since the notion "axis" is defined only by means of the notion "rotation" (as it's known an axis is a straight line around which a rotation is). So, it is clear that we get a circle in our definition: the notion "rotation" is defined by means of the notion "axis" and the notion "axis" is defined by means of the notion "rotation".

In definition a defining notion and a defined one must be different and independent. If it is not so then we get a mistake, which is called idem per idem or tautology. It should be admitted that in definition we get only a repetition of the same word, i.e. the words with the same meaning are used. For example: "light is something that is characterized by light", "size is something that can increase and decrease". The latest definition is a tautology because to decrease means to become less in size, and to increase means to become larger in size, and if we define a size by means of something that can increase or decrease then obviously the defining notion contains the defined one.

3. The definition must not be only negative, *it must define qualities peculiar to a notion, but not alien to it,* while the last ones are not important for us and besides there can be mentioned too much of them. For example, take the notion "a theater is a building that can be used for living". If A will be a building for living, then not-A will be the number of buildings that are not used for living. So, this definition is not useful for us. The definitions that can be related to the number of useless one are: "liquid is something that is not firm or gaseous", "point is something that doesn't have parts or any size". The negative notions do not expose the meanings of the notions, they leave the meaning indefinite. That's why the negative notions do not reach the aim of definition – they do not expose the meaning of the defined notion, or make the contents of the notion clear.

The negative definitions can be used only in that case when a defined notion has a negative character. For example, "foreigner" – is a person of the different country.

4. The definition must be clear, i.e. in a definition must not be used the ambiguous, metaphoric or incomprehensible expressions. If this rule is not followed it leads to the attempt to make something unknown clear by means of something even more unknown (ignotum per ignotius). For example, the expression – "architecture is stark music" – is a figurative expression, and the meaning of the term is not exposed. If we say "eccentricity is peculiar idiosyncrasy", then we try to explain the unknown notion by means of the more unknown one.

Methods of Definition Substitution. In order to make our definitions exact, the previous four conditions should be followed. But one should not think that all notions can always be defined by the same way. It can happen that we get to know the notion not by means of definition, but by some other means. Here are some means that substitute the definition.

1. Indication. If, for example, we want to explain someone what one or another color, sound etc. means, we will be able to do

it only if we contact him with the particular color, sound etc., i.e. we will make him to perceive it. Such way of getting known is called indication.

2. Description is used while getting known with individual objects or with the qualities that an object possesses. In such case the qualities are performed most exactly. For example, the description of the Dnieper written by N.V. Gogol, the Rhine Waterfall described by N.M. Karamzin and so on. In botany the structure of a flower, the process of fertilization etc., in chemistry chemical reactions are described.

3. Characterization allows exposing important qualities of an object or a phenomenon. If we need to expose to someone what "creative imagination" is, instead of defining we will pick out the quality that one or another kind of imagination possesses. For example, we say that creative imagination is characterized by a novelty of combination, and for the reproduced it's characterized by precision. One or another person is characterized by a quality: a soldier possesses courage, a doctor is human etc. The typical quality of crucifers' family is flowers with four leaves of the bell and with four petals of corona, situated cross-wise, with two short and four long stamens.

4. Comparison is used in that case when we get to know a notion comparing it to another one that is alike. We can give the notion of heat conductivity of one object comparing it to translucent. For example, if we say that heat conductivity in respect of heat rays is the same as lucidity in respect to luminous rays. Comparison is mostly used when one notion is exposed by means of another one that is clearer. For example, when one abstract notion is exposed by means of a concrete one. For example, "life is a school of experience", "law is an embodiment of a moral idea", "conscience is an inner judgment".

5. Distinguishing is used when we get to know the contents of a notion indicating the distinction that exists between this notion and another one. For example, we say that "enthusiasm" differs

from “fanaticism” because it is caused by something noble and doesn’t cross the limits of moderation.

Questions for revision:

1. What is the contents of a notion?
2. What are the complex and simple notions?
3. Which notions can not be defined?
4. What is a definition?
5. Enumerate the conditions of definition correctness?
6. Which definitions are too narrow and which ones are too wide?
7. When does a definition make a circle?
8. Why must not the qualities that a definition possesses have a negative character?
9. Name the methods that substitute a definition and pick out the peculiarities of each method.

LOGIC EXERCISES

Examples:

Analyze the following definitions

1. Light is an absence of darkness.

The definition is wrong. The third rule is not followed.

2. A human is an animal building a house.

The first rule is broken. Besides, in this definition inessential qualities are presented. Here belongs the definition “a human is an animal with two legs and without feather”.

3. A dog is a domestic animal.

The first rule is not followed. The word combination “a domestic animal” is an inessential quality.

4. Noun is a word defining object.

The definition is correct. “Word” is gender; “defining object” is type distinction.

5. Suffering is a character discipline.

This is not a definition.

6. Vice is a contrast of a virtue.

The definition is wrong. The third rule is not followed.

7. Identity is a thing that makes the things identical.

The second rule is not followed.

8. Alcohol is a type of medicine.
The quality is inessential.

Tasks:

Analyze the following definitions

1. Life is a sum of life functions.
2. Mineral are the matters that are not produced by means of plant or animal life.
3. Square is a four-sided rectilinear figure which sides are equal.
4. Triangle is a figure made by cone dissection through its upper flatness that is perpendicular to its base.
5. Liquid is something that can be poured out.
6. Rest is an absence of disturbing.
7. A soldier is a courage person who is ready to die for his Motherland.
8. A giraffe is an animal that eat leaves, has long front legs and a very long neck.
9. Gold is metal, atom weight of which is 196.2.
10. Civilization is a society where science and art are more or less developed.
11. Ignorance is a blind guide.
12. Ignorance is a gap in knowledge.
13. Language is an expression of thoughts by means of words.
14. A dialect is a language form related to a part of a nation.
15. A lion is a king of animals.
16. A barometer is a device foreseeing weather.
17. Hydrogen is a gas that doesn't maintain neither burning nor breathing.
18. Railway roads are communication means of people.
19. Hypotenuse is a side of a right-angled triangle lying opposite a right angle.
20. Water is a nature beauty.
21. Toadstool is a poisonous mushroom.
22. A dog is a man's friend.
23. Mercury is the only liquid metal by normal temperature.
24. Quinine is a febrifuge.
25. Circle is a closed curve.
26. Quail is a step bird.
27. Iambus is a disyllabic pile stressed on the second syllable.
28. A cross is two crossed crossbars.

Topic 5. ON DIVISION OF NOTION

Task of Division. A process of division (divisio) differs from a process of definition. The difference between them consists in the fact that a definition reveals a content of notion and a division reveals its volume. A task of division consists in pointing out all kinds, set of which make up the volume of said notion. For instance, a notion "triangle" can be divided as following:

Triangle *(A)* { **Right-angled *(B)***, **Acute-angled *(C)***, **Obtuse-angled *(D)*** }

Analyzing a notion "triangle" (*A*), we enumerated all particular notions: *B, C* и *D,* which belong to the volume of this more general notion, which belongs to them as a genus to its kinds.

A notion, volume of which we are reveling, is called **divisible** (totum dividendum), and those kinds which are received after division are called **members of division** (membra divisionis).

Basis of Division. When we are performing a division of genus into its kinds, we are paying our attention on those characteristics, which one kind possesses and other lacks. That characteristic which enables us to divide a genus into kinds is called a basis of division (fundamentum divisionis). The basis of abovementioned division of notion "triangle" was the magnitude of angles in the triangle. But we can divide the same notion according to another basis, for instance, to choose as a basis a ration of triangle sides due to their magnitude. Thus, a division will be as following:

Triangle *(A)* { **Equilateral *(B)***, **Isosceles *(C)***, **Scalene *(D)*** }

The process complicates to some extent, if we divide the received from division kinds into sub kinds (this process is called **subdivision**). So, for instance, a kind of notion "triangle", especially obtuse-angled triangle (or any other kind) can in its turn be divided into sub kinds: equilateral and scalene. It is known that both division and subdivision will be referred to the same notion.

Dichotomy. During the process of division sometimes one can use a method which is called dichotomy and which consists in the division of said notion ***A*** into the contradictory notion ***B*** and ***not B.*** Let's choose any notion which should be divided, for instance, the notion "human being". Further we separate some of its kinds into one group, which consist in this notion, for instance, a kind "Slav", and to the second group – "not Slav" – we separate all other kinds. Then with this second negative notion we perform the same procedure: we divide the notion "not Slav" into two groups. To one of them we separate the sub kind "Frenchman", and to another – all kinds that left, joining them as one notion "not Frenchman"; then we perform the same action with this notion as with previous one and we continue our division until it is depleted.

Human being { **Slav**, **Not Slav** { **Frenchman**, **Not Frenchman** **etc.**

This method has the drawback that every time it leaves quite indefinite a part of divisible notion, exactly that part, which is marked by particle **"not"**. But on the other hand, this method facilitates the most difficult process of division, because it gives exhaustive character, that's why it is sometimes called exhaustive division. We can explain the exhaustive character of this division with the help of following example. If we divide all inhabitants of Europe and Asia into races – white and yellow, then it is seen that there are some nations that cannot undergo any of these races and

we are not able to insert them into our division. Though it will not happen if we use dichotomic division.

Earth Inhabitants { **white**; **not white** { **yellow**; **not yellow** }

etc.

Within such division every new tribe should be included into the last group, which is neither white, nor yellow. These are advantages of dichotomic division.

Rules of Division. The division should undergo a number of rules:

1. The division should be adequate or commensurate. It means that if we enumerate the kinds of said genus notion according to some basis or principle, we should enumerate exactly all kinds of it, without lessening or enlarging their quantity, i.e. the sum of kinds should be equal to the divisible genus. If during the division we don't enumerate all kinds, i.e. if the sum is less, then we will get incomplete division. If we include in the volume of divisive notion kinds, which don't belong to it, then we will get too extensive notion, i.e. the mentioned sum will be bigger. For instance, having chosen as the basis of division of "triangle" notion the magnitude of its angles, we could get such a division:

Triangle { **Acute-angled**; **Obtuse-angled** }

This division is not complete, because we don't have one member of division, because in the division of notion "triangle" there is one more kind, which was omitted by us while dividing, it is Right-angled triangle.

The division of people into vicious and virtuous is also incomplete, and the division of scientific theories into true and false is incomplete too, because in these divisions intermediate stages are omitted. Beside vicious and virtuous people there are people about

whom one cannot say that they are virtuous. Beside true and false theories there are theories which are partly true and partly false.

The mistake will occur if we while dividing some notion insert into its volume such kind which doesn't really belong to its volume. If, for instance, we divide the notion "tree" into "oak", "fir", "violet", then because the kind "violet" belong to the volume of another notion, at such a division of notion "tree" it appears mistakenly among members of said notion.

2. **The members of division should exclude one another.** This demand will be clear if we take for an example the following division:

Books { **French**, **German**, **Dictionaries, etc.**

This division is wrong, because the notion, for instance, "French books" and the notion "Dictionaries" don't exclude one another: a book can be both French book and dictionary at the same time. Or we can take for an example also another division of notion "books":

Books { **useful**, **understandable**, **interesting, etc.**

Here one kind of books don't exclude another kinds from its volume: an useful book can be at the same time both understandable and interesting. Mistakes both in the first and in the second examples of division were made because the third demand of right division was not followed:

3. Division should have one basis. While dividing of notions most frequently occurs the mistake, which consists in the fact that while dividing the basis of division is changing. For instance, let's make the division of European folks:

European folks { **Muslims**, **Christians**, **Frenchmen**, **German people, etc.**

This division is wrong because first we took the notion "religion" as a basis and then we changed it into another notion "nationality". Also there is another example:

Rectilineal figures { **Triangles**, **Parallelogram**, **Rectangle**, **Polygon** }

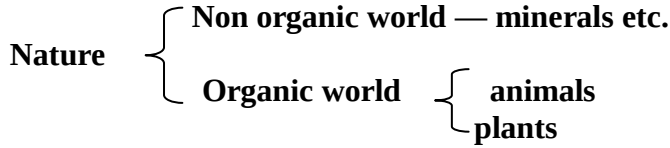
This division is also wrong, because here different basis for division are intersected as the number of sides, direction of sides, multitude of angles. Such a division is called crosswise.

So, the third condition of right division consists in *observing of the basis of division while consecutive enumeration of kinds of divisible notion.* But it should be noticed that the basis of division should be observed only at the first division of the notion; at secondary division, i.e. at sub division, the main division should be changed. Thus for instance, if we divide the notion "triangle", having chosen the division according to multitude of angles as a basis as acute-angled, right-angled and obtuse-angled, then when we wish to continue the division of one of these members of division, we should change the basis of division. Thus, the notion "acute-angled triangle" we can divide further if we chose as the basis of division not the multitude of angles, but the ratio of sides to its multitude.

Triangle { **1) obtuse-angled**, **2) right-angled**, **3) acute-angled** { **a) equilateral**, **b) isosceles**, **c) scalene** }

4. The division should be continuous, i.e. while dividing any notion one should chose the closest inferior genus; otherwise we will get the leap in division. If the notion "nature" is divided into 1) «animals», 2) «plants», 3) «minerals», then in this division there is too sudden transition from the notion "nature" to the notions "minerals", "animals". In order to correct the mistake, we should insert another two mediate links between the notion "nature" and

members of abovementioned division, especially the notion "non organic world" and "organic world". Then, the division will be as following:



Questions for revision:

1. What is the task of division?
2. What is called divisible notion?
3. What are called the members of division?
4. What is the basis of division?
5. What is dichotomy?
6. Enumerate the rules of division.
7. Give the examples for each rule and point out the usage of each rule.

LOGIC EXERCISES

Examples:

Explain the following divisions:

1. Planar figures are divided into curvilinear and rectilinear.

The division is correct; it contains one fundamentum divisionis; it has exhaustive character, because every planar figure should be either curvilinear or rectilinear.

2. Feather is divided into steel pen-points and anserine feather.

The division is not complete, because there are golden pen-points, aluminum pen-points, etc.

3. Animals are dividing into vertebral and non vertebral.

It is correct dichotomic division.

4. Material bodies are divided into solid, liquid and gasiform.

The division is correct.

5. Light is divided into artificial light, blue light and moonlight.

The division is incorrect; it has different basis.

6. The books can be bound and not bound.

It is correct dichotomic division.

Tasks:

Explain the correctness of following division:

1. People are divided into such races: white, yellow, black.
2. Fine arts are divided into painting, drawing, sculpture, architecture, poetry and photo.
3. Samples of government are divided into monarchy, tyranny, oligarchy and democracy.
4. Books are divided into interesting and not interesting.
5. People are divided into those who can lend money and those who can borrow them.
6. People are divided into Frenchmen, Asiatic, non religious and barbarians.
7. Buildings are divided into high and low.
8. Inhabitants of any city are divided into men, women, sons and daughters.
9. Fractions can be more than one, less than one and equal to one.
10. Trees can be coniferous, low, timber, fruit.
11. Subjects are divided into compulsory and optional.
12. Amounts can be equal and non equal.
13. According to the eyesight ability people are divided into short-sighted and farsightedness.
14. Soil can be fertile and barren.
15. Teeth are divided into corner teeth, canine teeth, small and big grinder.
16. Bodies by their ability to spread electric state are divided into conductors, semiconductors and non conductors.
17. Sources can be cold, hot, salty, sulphuric sourses.
18. Proverbs are divided into old, new, allegoric, moral, domestic, historical proverbs.
19. Wire can be copper, silver, thick, thin, telegraphic wire.
20. Greeks divided all people into Greeks and barbarians. What kind of division is that? Is it correct?

Topic 6. ABOUT PROPOSITION

Cognition and Proposition. If we had only concepts and notions, but there were not any conjunctions or connections, it would have been difficult to realize anything. Cognition is possible only then, when we cope with verity and falsity; and the question about verity or falsity appears only when there are known connection in the process of proposition about anything.

Thus, when I spell the word "house", then in the notion, expressed by this word, there is nothing either true or false. When I say "vampires are existing", "dragon has wings", then I state something true or false. Therefore, we can speak about verity and falsity only in that case when we deal with proposition. Proposition always deals with any objective reality.

Proposition is known mental construction; when it is expressed by words it is called **a sentence.**

Grammar Analysis of Sentence. In the sentence we often express ourselves on some matters. The thing according to which we are making our statement is called **subject,** and what we are stating about it is **predicate.** The typical simple sentence is *"A is B", "A is not B"*. In these sentences *A* is a subject (subjectum), *B* is predicate (praedicatum); «is» and «is not» is called **linking element** (copula), because it serves for linking of subject and predicate. Subject is usually marked as S, predicate – as P (initia; letters of words subjectum, praedicatum).

I should notice, that when we are speaking about proposition, we mean the logical point of view, and when we are speaking about a sentence, we mean grammatical point of view.

Form of Propositions. Propositions, no matter what they are, always correspond the connection of subject and predicate, but they change according to subject, predicate or connection between them. Thus, in order to familiarize with different forms of propositions we should study different changes of subject, predicate and connections between them.

I. First of all let's study the peculiarity of proposition dependent on the changing of subject.

Subject can be definite and indefinite. Propositions with indefinite subject are so-called impersonal propositions, for instance, "it is dawning", "I am boring", "it is sad", "it is painful". Between the propositions with definite subject we can differentiate singular, particular and general propositions. Singular propositions are those, in which the subject is any individual notion, for instance, "Newton opened the law of gravitation". Particular propositions are those, in which the subject of proposition is a notion, which was taken partially from its volume, for instance, the proposition "some S is P". General propositions are those, in which the subject serves for expression of class of things or phenomena, for instance, "spiders are arthropods".

II. Propositions according to the form of **predicate** can be divided into narrative, descriptive and explanatory. It should be mentioned that the subject is also an expression of notion of thing, subject, event, whereas the predicate serves to define those changes, which the thing can undergo.

We speak about thing as something coming, constant, differ from its features by the fact that it remains relatively unchangeable, whereas the latter are changing. This coming notion is called substance, and those that is changing in it is called accident. Accident can be either in the condition of state, or in the condition of quality; in this case the predicate expresses either state, or quality of some thing, but sometimes it can express the thing either.

Features of subject and predicate define the form of proposition.

a) Narrative propositions contains in their predicate the statement related to the events, state, processes or activity; predicate here is always the notion of state, besides about narrative things the state mostly of fast transition are expressed. These propositions are true only for definite period of time. For example, "Cesar crossed the Rubicon", "the rose is flowering in our garden", "this fire is fervent". These propositions can be called narrative, because mostly they are used in stories.

b) Descriptive propositions. In the descriptive propositions one

or several things gain some quality or number of qualities and more or less constant qualities are meant. The subject is always some definite subject or thing. For instance, in the proposition "fire is fervent" the predicate expresses the notion of quality or features of subject. The same thing should be said about predicates in the following propositions: "snow is white", "motion of train is quick", "rose is beautiful", "whale breathes by his lungs", "sky is blue". The designation of propositions of such a kind as descriptive is carried out because of the fact that they are used mostly in descriptions.

c) Explanatory proposition brings any thing under the genus notion, and in this case the predicate expresses the notion of thing. For instance, "gold is metal", "whale is mammal", "this is steel", "burning is chemical process", "parabola is conic section".

III. And finally, the third class of propositions – these are propositions, in which definite **relation between notions of subject and predicate** are expressed. We can differentiate them as:

a) Propositions of identity. In the propositions of such kind the notion of subject and predicate have the same volume, i.e. in the sentence the subject and predicate are equal. For instance, "every triangle is equiangular triangle", "V.I.Vernadsky – the founder of noosphere studies". In the Mathematics the notions are often used which express the identity; to them belong notions which are expressed by equations. For instance:

$$(a+b)^2 = a^2 + 2ab + b^2; \qquad a^m * a^n = a^{m+n}.$$

b) Propositions of subordination coincide with explanatory notions. Here propositions of subject and predicate are not identical, because their volumes differ from each other. Here the notions with less broad volume subordinate the notion with more broad volume. That's why such propositions can be called propositions of subordination. For instance, "Sun is unmovable star", "this is right triangle", "dog is domestic animal".

c) Propositions relating to space, time and cause. In the sentence "house is situated in the street" we are speaking about well-known spacing relation between "house" and "street"; "situated in the street" creates the content of predicate. In the

proposition “Alexander Macedonian lived before Christ” the predicate is “lived before Christ” and expresses the time relation. “Sun produces warm” (proposition of cause).

Proposition of Existence. If we take any proposition, in which *P* is expressed as for some S, then in such proposition we don’t state directly that *S* exists outside of man’s thinking, because in this case the known logical thinking is established between *S* and *P*. If we, for instance, take the proposition “no part of circumference is straight”, then we don’t ask a question about is there any circumference in form of exact geometrical circus. Even if we didn’t have a belief that such circus are existing then we can say the mentioned proposition; because we only stating a known relation between subject and predicate. On the contrary such propositions as “world is existing”, “sun is existing”, “antipodes are existing” are called to state the being or existence of the logical subject. Propositions, which subscribe only existence to the notion of subject, are called propositions of existence or existential. It is obvious, that the word “is” in these propositions is not link but a predicate and means “to exist”.

Analytic and Synthetic Propositions. Proposition, in which we state something regarding the subject that is already contained in it is called analytic. For instance, in the sentence of proposition “every body is extended” the characteristic of extent is already contained in it. We cannot think the notion “body” without thinking of its extent. That’s why if we are saying that the body is extended then we only unfold, analyze the thing which is already contained in predicate. That’s why the proposition analytic.

The proposition in which the predicate doesn’t include to the content of subject, in which the predicate adds something new to its content, differs from the analytic proposition. Such propositions are called synthetic. They don’t unfold the content of subject, but add something new to it. These propositions are called also the propositions, which enlarge one’s scope, when the analytic propositions are called the propositions which explain the cognition.

If to examine propositions from the point of view of their origin, then the difference between synthetic and analytic propositions should be considered as relative, because sometimes features which we consider to be connected analytically, in fact are connected synthetically. For instance, the proposition "lion is a carnivore" should be accepted as analytic, because the characteristic of carnivorousness is contained in the notion "lion". But this proposition is analytic now, when we know well the content of the notion "lion". When we don't know the notion "lion", the proposition has synthetic character, because then the characteristic of carnivorousness joins the notion "lion". Because of constant usage of notion "lion" together with the characteristic of carnivorousness this proposition became analytic.

But beside the mentioned in this chapter classification of propositions there is one more classification, which we should know, because it lies in the basis of all further logical constructions.

Questions for revision:

1. What is relation between cognition and proposition?
2. What difference is between sentence and proposition?
3. What is the basis of proposition division?
4. What kinds of proposition do exist depending on the changing of subject and what difference is between them?
5. What kinds of proposition do exist depending on the changing of predicate and what difference is between them?
6. Which propositions are called the propositions of existing?
7. What is the difference between analytic and synthetic propositions?

LOGIC EXERCISES

Examples of analysis of logical form of propositions:

Create logical form i.e. to express the forms A, or E, or I, or O, in the following propositions by means of proposition:

1 Fish is breathing by gills.
= All the fish are breathing by gills.
2. Laziness never brings to the good.
= No laziness brings to the good.
3. Beautiful and useful are coinciding partially.
= Some beautiful and useful are coinciding partially.
4. Most of admiring people are unhappy.
= Some admiring people are unhappy.
5. Only one metal is fluid.
= Some metals are fluid.
6. A good horse never has a bad colour.
= No good horse has a bad colour.
7. A good beginning is a half of business.
= All things began well are a half of business

Tasks:

To create a logical form of the following propositions:
1. Not everybody who is present here has badges.
2. Only those who praise virtue are virtuous.
3. No one among present willed to join this opinion.
4. Only earnest people are admired.
5. Not all his answers were false.
6. Only the natives of Africa can bear African climate.
7. Not all the gold that glitters.
8. Not everyone can make such an action.
9. Only merit is worth of reward.
10. Only Protestants can take English throne.
11. There is nothing more beautiful than truth.
12. No one except brave deserves respect.
13. Only certified specialists have right for consulting.
14. Axioms are obvious.
15. Everything is well that ends well.
16. If a body is warmed, it is expanded.
17. Kind people sometimes act badly.
18. Not many people know the price of virtue.
19. Only clever creatures are responsible.

20. Only rich are vain.
21. There are a lot of good people in the world.
22. Not every finding is pleasant.
23. Most salts are soluble in the water.
24. Not all writers are classics.
25. Nothing is constant under the Moon.
26. To live a life is not so easy.
27. Laziness is a mother of all vises.
28. The axe of no one touches the stems of young trees.
29. Don't trust every gossip.
30. The plants which don't have blossom are often met.
31. There is no man who could admit the soundness of this idea.

Topic 7. DIVISION OF JUDGMENTS

Division of judgments. The judgments in logic are divided from four points of view: 1) quantity, 2) quality, 3) relation, 4) modality.

1. Quantity of judgments. When judgments are treated from the point of view of quantity, the attention is paid to the volume of a subject: whole or partial, i.e. in other words, whether the fact that is affirmed by the predicate about the subject that is taken wholly is true, or it is true only towards the subject taken partially. If I say "all the plants live", then in this judgment the predicate "live" is true towards all the plants, towards the whole class of plants, towards the concept taken in whole volume. If I say "some of the plants are conifers", then predicate "conifers" is true only towards the part of the volume of plants. First judgments are called *general*, the second ones are *particular*.

The formula of general judgments: **All *S* are *P*.**

The formula of particular judgments: **Some *S* are *P*.**

Single, or individual, judgments should be distinguished from particular judgments. For example, the judgment "Gutenberg is the inventor of book printing" is a single judgment. Individual judgments usually refer to general judgments, because the predicate in these judgments refer to the subject taken in the whole volume. The same should be said concerning any judgments, in which the subject is expressed by the concept of single thing. For instance let's take the judgment: "self-control is virtue". Evidently, that in this judgment any self-control is thought.

2. Quality of judgments. From the point of view of quality the judgments are divided into affirmative and negative. Their formulas are following:

***S* is *P*. –** an affirmative judgment;

***S* is not *P*.** – a negative one.

If we add the predicate to the subject, it is an affirmative judgment; if we take the predicate away from the subject, then it is

a negative judgment. For example, the judgment "people are partial towards themselves" is an affirmative judgment, because we attach the known predicate to the subject, we consider it to be part of the content of the subject. But the judgment "people do not yield to flattery" will be a negative judgment, because the predicate "yield to flattery" we take away from people, i.e. we consider it not to be a part of the subject "people". Therefore, from the point of view of quality, we define whether the predicate is being attached or taken away.

The classes of judgments, which we get by dividing them from the point of view of quantity, can be joined with the classes, got by the dividing them from the point of view of quality, and then we get ***general-affirmative*** and ***quotient-affirmative***, ***general-negative*** and ***quotient-negative*** judgments.

The formulas of these judgments are the following:

1. A general-affirmative judgment: "***all S are P"***. For example, "all people are afraid of earthquakes".
2. A quotient-affirmative judgment: "***some S are P***". For example, "some people have mobile phones".
3. A general-negative judgment: "***none of S is P***". For example, "none of people is omnipotent".
4. A quotient-negative judgment: "***some S are not P***". For example, "some people do not have a leather jacket".

To make the designation of the classes of judgments shorter it is traditional to use symbols. They take symbol **A** for a general-affirmative judgment, the first vowel of the verb **a**ff**i**rmo=I affirm; symbol **I,** the second vowel of the same verb is taken for a quotient-affirmative judgment; for a general-negative judgment symbol **E** is taken, which is the first vowel of the verb n**e**g**o**=I negate, symbol **O,** the second vowel of the same verb is taken for a quotient-negative judgment.

Hence, the symbols of the judgments can be designated in the form of table:

A. – All ***S*** are ***P***.

I. – Some ***S*** are ***P***.

E. – **N**one ***of S*** is ***P***.

O. – Some ***S*** are not ***P***.

3. Relations between subject and predicate. The judgments also differ in relations between subject and predicate. From this point of view the judgment can be divided into categorical, conditional, and disjunctive. If I say "all the people are mortal" then I take the relation between the subject and the predicate unconditionally. It will be a categorical judgment in which the predicate is affirmed or denied relative to the subject without any time or space limitations, or under any other conditions. When the judgment is limited by any conditions, it is a conditional judgment, and when there is some indefiniteness in the judgment then it is a disjunctive judgment.

Categorical judgments. The scheme of a categorical judgment is:

S is P.

For example: "The Earth revolves around the Sun".

Conditional or hypothetical judgments. The scheme of a conditional judgment is:

If *A* is *B*, then *C* is *D*.

An example of conditional judgment: "if it rains, the soil will be wet". Here in the second judgment the predicate can be ascribed to the subject under the condition of assumption that the first judgment is true. Another example of the conditional judgment: "if the Moon stands between the Sun and the Earth, then the Sun is eclipsed". From these examples we can see that condition given in one of the judgments make the relation between the subject and the predicate in the other not categorical, but conditional. The first judgment is customary called ground and the second one is consequence. In the conditional judgments there are two judgments that relate to each other as ground to consequence. The judgment that contains condition is also called previous (antecedens); the judgment that contains the consequence is called posterior (consequens).

Disjunctive judgments. Disjunctive judgments are of double kind:

1. *S* is either *A*, or *B*, or *C*.
2. Either *A*, or *B*, or *C* is P.

The difference between these two kinds of disjunctive judgments consists in the following. First kind can have two, three and more predicate by one subject. The second kind can have two, three or more subjects by one predicate. The possibility of several subjects by one predicate and several predicates by one subject makes the judgments indefinite. Let us take the judgment "a triangle is either acute-angled, or obtuse-angled, or right-angled". There is one subject and three predicates in this judgment.

Attaching any of the predicates to the subject, we exclude all other predicates. Owing to this, if one of the judgments is true, the others must be false. If I say that the triangle is right-angled it means that it is not acute-angled and not obtuse-angled. The next judgment can be an example of the second kind of the judgments: "either Francis Bacon, or William Shakespeare, or a person equal to their talent wrote the works, which are ascribed to Shakespeare".

Conditions of correctness of disjunctive judgment are the same as the conditions of correctness of division; they consist in the full stating of the members of division and excluding them by each other. The following judgments deviate from the truth: "the triangle can be either right-angled or obtuse-angled"; "the man can be either educated or poor" (what are the mistakes?).

Conditional-disjunctive judgments. When joining the conditional and disjunctive judgments conditional-disjunctive judgments appear. Their scheme is following:

If *A* is *B*, then *C* is either *D*, or *E*, or *F*.

In more general form it looks like:

If there is *A*, then there is either *a*, or *b*, or *c*.

For example, "if somebody wants to get higher education, then he should study either in the university, or institute, or academy".

4. Modality of judgments. The fourth relation between the judgments is possible from the point of view of modality. Here the qualification, i.e. in what way (cum modo) the predicate is attached to the subject, is being examined here. There are three types of such qualifications, and therefore there are three categories according to modality:

Problematical **–** "*S* is likely P". For example, "Iliad is likely a work of collective creativity". Here the connection between subject and the predicate and disunity between them is shown here as a known assumption.

Assertive **–** "*S* is *P*". For example, "Kyiv lies on the Dnieper", "water consists of hydrogen and oxygen".

Apodictic **–** "*S* necessary must be *P*". For example, "two straight lines can not close the space".

The analysis of the examples given shows that problematical judgments are characterized by some limitation of the relation between the subject and the predicate (probability, possibility is affirmed). The relation between subject and predicate in the assertive judgment is evidently affirmed, for the reality of a fact is affirmed. The affirmation in the apodictic judgment has features of necessity.

The assertive and the apodictic judgments are considerably different. The assertive judgments state something really existing, something quite trustworthy, but we always can think the opposite of that affirmed in the assertive judgment. Speaking about the apodictic judgments we can never think the contradicting judgments. For example, if we take the assertive judgment "Kyiv lies on the Dnieper", I can think that Kyiv lies not on the Dnieper, but on the Neva, for instance. If I take the apodictic judgment "two straight lines can not close the space", then I can not think otherwise, I can not conceive of the two straight lines closing the space. The apodictic judgment is of a necessary character. Let us look at one more example of apodictic judgment: 'if two quantities are equal to the same third one, then they are equal to each other'.

These three features: possibility, reality and necessity are characterized by three kinds of the judgments given. If either possibility, or reality, or necessity is expressed in the judgment, then we have either problematical, or assertive, or apodictic judgment.

Questions for revision:

1. How are judgments divided from the point of view of quantity and quality?
2. What four classes are judgments divided into and what are the designations for them?
3. How do judgments differ in relations between subject and predicate?
4. What are the schemes of the categorical, conditional and disjunctive judgments?
5. How are judgments divided according to modality and what is the difference between them?
6. What is the difference between the assertive and apodictic judgment?

Topic 8. RELATIONS BETWEEN THE SUBJECT AND THE PREDICATE AND THEIR VOLUMES

The relations between the subject and the predicate. We know that the statements are general-affirmative, general- negative, particular-affirmative and particular-negative. It's necessary to find out relations between the subject and the predicate in all the classes of the statements.

Statements A. Let's take a general-affirmative statement "all fishes are vertebral" (all S are P). In this statement we assert that that each fish is included in the class of vertebral. In other words, the class of things that we denote with the help of the predicate «vertebral» fully includes the class of things denoted by the subject.

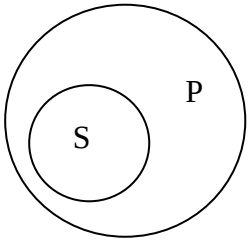


Fig. 10

But as long as there are other animals apart from fishes in the class of vertebral, the volume of the vertebral class is bigger than the fish class. If the concept S is included in the volume of P, symbolically we can present it with the help of circle S that is located inside circle P. That is why the general-affirmative statements in which the volume of the subject is lesser than the volume of the predicate can be symbolically presented as on the ***fig. 10***.

But if in general-asserting statements the subject and the predicate are equal concepts, their symbol will be different. Let's take the example: "All squares are parallelograms with equal sides and equal angles". In this statement S and P are equal concepts and they coincide in their volumes. That's why we cannot locate the circle S inside P as it was made in the previous statement, and we should show the reference of S and P as two coinciding circles ***(fig. 11).***

Statements E. Let's take a general-negative statement "None of the insects is vertebral". In this statement we deny any coincidence between the subject and the predicate, one class is located out of another class. In our minds we absolutely separate the subject class

from the predicate class. The relations between S and P in such statements are shown by two separate and not connected circles ***(fig. 12)***.

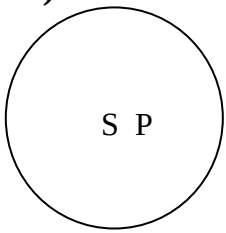


Fig. 11

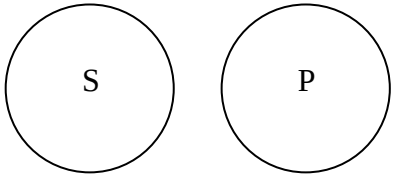


Fig. 12

Statement I. Let's take particular-asserting statement "some books are useful". In this statement a part of S class locates in the volume of P class, i.e. coincides with P class. If a part of S class coincides with P, circles S and P should have a common part, i.e. they should intersect. The relations between the subject and the predicate in the particular-asserting statements can be shown as it in on the ***fig. 13***. The part of S which is asserted in P is shaded on the picture.

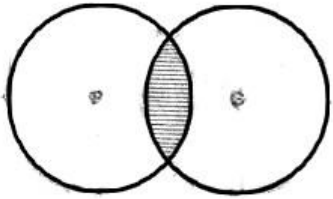


Fig. 13

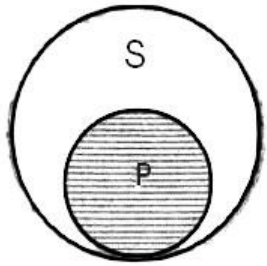


Fig. 14

Some particular-asserting statements can be shown another way. For example: "some animals are vertebral". If we consider the volumes of the concepts "animals" and "vertebral", we will see that the first statement is subdued to the second one, i.e. the volume of the notion "animals" include the concept "vertebral". That is why the symbol of such a particular-asserting statement will be as it is shown on the ***fig. 14***. It shows that from the S (animals) we point out the part that is P (vertebral). The part S that is discussed is shaded on the picture.

Statement O. Let's take a particular-negative statement "some books are not useful". This statement means that some books are not located in the class of the useful things. In this case some part of S is not located in the volume of P. If we show the subject and the predicate in the statement ***O*** as circles (***fig. 15***), these circles should have common and not common parts, i.e. they should intersect.

The shaded part of the circle means that in this statement it is said about this part of the subject, which is not included in the volume of the P concept, that it is located out of the concept P. It means that for the statement ***O*** we receive the same symbol as for the class of statements ***I***. The difference between them is that in statements ***I*** we pay attention to what coincides between S and P, and in statements ***O*** – what not coincides.

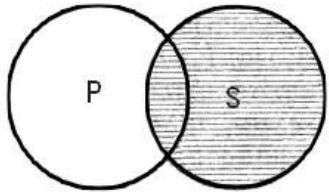


Fig. 15

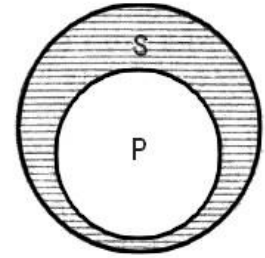


Fig. 16

With some of the statements of O class other symbol is applied. Let's take, for example, the statement "some snakes don't have poisonous teeth". Here again the concept of the predicate is subdued to the concept of the subject. As far as "snakes that have poisonous teeth" (P) make only a part of the class of snakes, the concept of P is a part of the volume of S concept (***fig. 16***). In the statement "some snakes don't have poisonous teeth" from the S volume we point out a part that is limited by the P circle. This part S that is located in the P circle is for the snakes that have poisonous teeth. The part that is located out of the P circle is for the snakes that don't have poisonous teeth. If we shade the part of S circle, that is located out of P, we'll show which part of the class is meant.

Volumes of the subject and the predicate. Now let's look at the statements from the point of view of the volume of their subjects and predicates. We will see that in some statements we take the subject or the predicate in the full volume, and in the other – not in the full. If the subject and the predicate are taken in the statement in the full volume, they are said to be distributed, if they are taken not in the full volume, they are said to be non-distributed.

In the statement A the subject is distributed because the predicate is stated relating all representatives of this or that class, but the predicate is not distributed, which can be easily seen on the abovementioned example "all fishes are vertebral". In this example we ascribe the known feature, in this case – belonging to the known class, all fishes; considering the vertebral we gain the knowledge only about some part of them, but not about all. That's why the statement A distributes its subject, but doesn't distribute it's predicate.

But in the statements A, in which the subject and the predicate are equal concepts, the predicate is taken in the full volume. E.g., as in the statement "all amalgams are quick-silver alloys".

In the statement E the statement and the predicate are distributed. If we take the statement "none of the insect is vertebral", in this statement we assert something about all insects – that they are not vertebral, and about all vertebral that they are not insects. From this statement we find out that none of the things that are located in the predicate cannot be found among things located in the subject. That's why the general-negative statement distributes the subject as well as the predicate, because we find out from it something about all class of the subject and about all class of the predicate.

In the statement I neither the subject nor the predicate is distributed. If we take an example: "some books are useful", we will not gain any knowledge either about all class of "books" or about all class of "useful things". From this statement we will only find out about some books that they are useful, but we will not find out what is included in the all volume of "useful things". We know about it from the other sources, but not from this statement. If we find out nothing definite about the all volume of the predicate of the

partial-asserting statement, it means that these statements don't distribute their predicates.

In the statement O the subject is not distributed, because when we say that "some animals are not vertebral", we take the subject not in the full volume, we say about some, not all animals. The predicate in the statement O is distributed, as we exclude S from all the volume of the predicate. Excluding a thing from a space, for example from a house, means delete it not from some part but from any part, from all the space, from all the house. Though some part of animals is included in the class of vertebral, the rest parts are excluded from all parts of the predicate.

The distribution of the subject and the predicate is systematized in the table:

Statement	***Subject***	***Predicate***
A	distributed	non-distributed
E	distributed	distributed
I	non-distributed	non-distributed
O	non-distributed	distributed

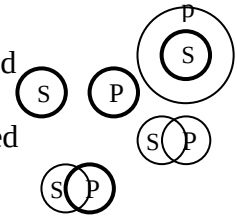


Fig. 17

The cases when the subject is distributed or not distributed are easily seen, because it is pointed by the words "all", "some", "none" etc. Considering the predicate the abovementioned scheme shows that the negative statements distribute, and asserting statements not distribute their predicates.

Questions for revision:

1. Show symbolically the relations between the subject and the predicate in statements of all classes.
2. In which cases the subject or the predicate is said to be distributed?
3. What is the sign for distinguishing of distribution and non-distribution?

LOGIC EXCERCISES

Represent symbolically as circles the following statements:

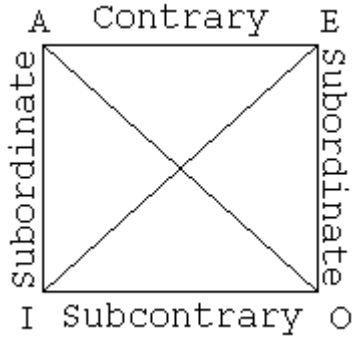
1. All metals are conductors of the heat.
2. Some of the metals are fragile.
3. Amalgams are mercury-alloys.
4. All dictionaries are books.
5. Not all books are dictionaries.
6. Some of books are dictionaries.
7. Many of the plants are not eatable.
8. Some of the animals don't have lungs.
9. Some of people do commerce.
10. Only work-people appreciate rest.
11. Some of modern common customs are ancient religious ceremonies.
12. Rivers are natural ways of communication.
13. All compounds of metal with oxygen are oxides.
14. None of Roman slaves possessed civil rights.
15. All gluts harm the health.
16. All horse-tails are cryptogrammic plants.
17. All reptiles are vertebrate.
18. Some of animals are vertebrate.

Point out the amount of the subject and the predicate in the statements:

19. Knowledge is power.
20. A habit blunts sensitivity.
21. Plants lack the ability of movement.
22. All parallelograms have equal opposite angles.
23. Some of parallelograms have equal adjacent angles.
24. Science cultivates mind.

Topic 9. OPPOSITION OF STATEMENTS

Essence of matter. We have seen that there are different classes of statements depending on what quality or quantity they possess. The statements, in which the subject and the predicate are the same, but which have different quality or quantity or both, are opposite. For example, the statements A and I, statements E and A are opposite.



The matter of opposition of statements is important. If objecting to somebody I don't admit the truth of his statement, nevertheless I can accept something as truth. For example, if somebody asserts that all people are wise, and I deny it, at the same time I realize that I can admit the truth of the statement "some people are wise". These two statements are compatible. If I assert that all people are mortal, I cannot admit at the same time that some people are not mortal. One statement turns to be not compatible with another.

Hence appears the necessity to consider all statements from the point of view of their opposition in order to show which statements are compatible or not compatible with one another.

In order to clarification we will use the scheme known as "logical square" (***fig. 18***). The scheme visually demonstrates mutual connection between the statements of all four classes.

Let's take a square and lay diagonals in it. At the vertexes of its angles we put letters A, E, I, O – i.e. symbols of four classes of statements. Let's take a statement and represent it in forms of all four classes: A – "all people are honest", E – "none is honest", I – "some people are honest", O – "some people are not honest".

Between statements A and O, E and I there is a relation that is called contradiction. These statements differ in quality and quantity.

Relation between A and E is called contrary. There common statements differ in quality.

Between A and I, E and O there is the relation of subordination. The statements differ in quantity.

Between I and O – relation of subcontrary. These two particular statements differ in quality.

Let's consider each pair of the statements separately.

Contradiction (A—O, E—I). I make a statement A – "all people are sincere". You believe the statement to be false. In this case you should admit as truth the statement O – "some people are not sincere". If you don't accept the truth of the latest statement, you cannot say that the statement A is false. Therefore if the statement A is false, the statement O must be truth.

Let's take the statement O – "some people ate not mortal". We must accept the statement as false because we believe the statement A – "all people are mortal" is truth. Therefore with statement O being false the statement A is truth.

If I assert that all people are mortal and you agree that it is true, you have to admit that taking this statement as truth we cannot admit being truth the statement O – "some people are not mortal". And vice versa – if we accept the statement O – "some people are not honest" being truth we cannot admit that the statement A "all people are honest" is truth.

> ***Conclusion*: from two contradictory statements when one statement is truth the other is false, and if one statement is false the other is truth. Therefore within two contradictory statements one must be true and one must be false. Two contradictory statements cannot be true simultaneously, as they cannot be false either.**

Contrary (A—E). If we accept the statement A – «all metals are elements» truth, it's impossible to admit that "none of the metals is element". Therefore if A is truth, E is false. If we accept the statement E – "no human is omniscient" as truth, then we have mo right to assert the statement A – "all people are omniscient".

Therefore if E is true, A is false. Consequently the truth of one of the contrary statements is followed by the falseness of the second.
But is the falseness of A consequently followed by the truth of E or the falseness of E by the truth of A? Not at all. We can find this out from the examples. Let's take a statement "all poor men are vicious" – and admit that this statement is false. Can we in this case assert the statement E – "none of the poor men is vicious"? Of course it's impossible because in real only some poor men are not vicious and some – vicious. If I make a statement E – "none of the diamond is valuable" and you deny the truth of this statement, would you have right to assert that "all diamonds are valuable"? Of course not. Denying my statement you can only assert that "some diamonds are valuable", admitting that "some diamonds are not valuable". Consequently by falseness of one of the contrary statements we cannot admit the truth of the second, because there can always be something in the middle.

> ***Conclusion*: within two contrary statements the truth of one statement is followed by the falseness of the second; though the falseness of one is not followed by the truth of the second: both statements cannot be truth (because if one is truth, the second is false), but both can be false (because by the falseness of one of them the second can be the same).**

Subordination (A—I, E—O). If A is true, then I is true too. For example, if the statement A – "all diamonds are valuable" is true, than the statement I – "some diamonds are valuable" is also true. If E is true, O is true. If "no human is omniscient", then of course it presupposes that "some people are not omniscient". The truth of particular statements depends on the truth of the general ones.

But can we say that, vice versa, that the truth of general statements depend on the truth of particular statements? No. Sure, if I is true, then A can be not true. For example, the statement I – "some people are wise" – is true. Will consequently be the statement A – "all people are wise" true? No. If O is true, then E can be not true. If we admit O – "some people are not sincere"-

true, can we consequently admit the statement E – "none is sincere" as truth? Of course, not.

The falseness of the general statement makes indefinite the falseness and the truth of subordinate particular one. Denying the truth of A we cannot say if I is true or false. Denying the truth of E we can neither assert nor deny the truth of O. If we for example deny the truth of A – "all people are honest", we can admit the truth of the statement I – "some people are honest". If we deny the truth of the statement E – "no human is wise", we can admit the truth of O – "some people are not wise".

But the falseness of the particular leads to the falseness of the general. If I is false, A is false too. If we cannot say "some people are omniscient", because it is false, then for sure we cannot say "all people are omniscient". If O is false, E is false. If we cannot say "some people are not mortal", we cannot say "no human is mortal", because if we cannot assert something about a part of a class, we cannot assert it about the whole class.

Conclusion: **The truth of the particular statement depends on the truth of the general statement, and not vice versa; the falseness of the particular leads to the falseness of the general, and not vice versa.**

Subcontrary opposition (**I—O**). If I is true, then O can be true. If the statement "some people are wise" is true, what can be said about the statement "some (other) people are not wise"? This statement can be true because some people can be wise, and some – not. If O is true, then I can be true. If we say that "some people are not sincere", at the same time we can suppose that "some people are sincere"; one statement doesn't exclude another. Therefore, the statements I and O can be true at the same time.

If O is true, I can be true. If we say that "some people are not sincere", at the same time we can suppose that "some people are sincere"; one statement doesn't except another. Therefore, statements I and O can be true at the same time.

If I is false, O is true. If we cannot say "some people are omniscient", it happens because the contradicting statement E – "no human is omniscient" is true, and if this statement is true, then the subordinate statement O – "some people are not omniscient" is true.

If O is false, then I is true. If “some people are not mortal” is false, it happens because of the truthfulness of the contradicting statement “all people are mortal”; truthfulness of this statement leads to the truth of subordinate statement “some people are mortal”.

Conclusion: **Both subopposite statements can be true at the same time, but cannot be false simultaneously (because by the falseness of one statement another is true).**

The strongest opposition. We have dealt with pairs of contrary and contradictory statements. Which of them make the most opposition? We should think that these are statements A and E; between these statements the most opposition occurs when we compare them. If someone says that “all books contain truth”, and we mention that “no book contains truth”, the opposition between the first and the second statement is very big. The opposition is not so big if to the statement “all books contain truth” we say that “some books don’t contain truth”. It’s obvious from these examples that the opposition between A and E is more than between A and O, i.e. the disagreement is more in the first case than in the second. Therefore the most opposition is in the contrary statements. This opposition is called diametric.

Though the biggest opposition exists between contrary statements, it’s more comfortable to use contradictory statements while disproving of general-asserting or general-negative statements, because statements I or O are less risky than A or E.

Let’s assume that someone asserts “all books are useful”. This statement can be rejected by showing that “no book is useful”, but also by saying that “some books are not useful”. The second way of rejection is preferable: if we prove that “some books are not useful”, it would be enough to reject the statement “all books are useful”. It’s easier to show the uselessness of some part of books then to show that none of books is useful. It’s less risky to assert O than E. that’s why we seldom disprove general-asserting statements with the help of the general-negative ones, but more often with the help of contradicting negative-particular sentence. The same is

fairly for the particular-negative sentences in general. It works with another pair of the contradictory questions.

It's easier to show the uselessness of some books then to show that no book is useful. It's not so much risky to assert O then assert E. that's why we seldom deny the general-asserting statement with the help of general-negative one, and more often – with the help of contradicting particular-negative. It works with the other pair of contradicting statements.

Let's present the relations between statements with the help of the table:

If	**A** is true,	then ***E*** is true,	***O*** is false,	***I*** is true
»	**E** »	then ***A*** is false,	***I*** is false,	***O*** is true
«	**I** «	then ***A*** is indefinite,	***O*** is indefinite,	***E*** is false
«	**O** »	then ***E*** is indefinite,	***I*** is indefinite,	***A*** is false
If	**A** is false,	then ***E*** is indefinite,	***I*** is indefinite,	***O*** is true
«	**E** »	then ***A*** is indefinite,	***I*** is true,	***O*** is indefinite
»	**I** »	then ***A*** is false,	***E*** is true,	***O*** is true
»	**O** »	then ***A*** is true,	***E*** is false,	***I*** is true

It's possible that the table is hard to be learned by heart, but it can be made by the student if he or she understood the material properly.

Questions for revision:

1. What statements are called opposing?
2. Represent the logical square.
3. What statements are called contradicting?
4. What relation of opposition exists between contradicting statements?
5. What statements are called contrary?
6. What relation of opposition exists between the contrary statements?
7. What statements are called the statements of subordination?
8. What relation of opposition exists between statements of subordination?
9. What statements are called subcontrary statements?
10. What relation of opposition exists between subcontrary statements?
11. Between what statements is there the strongest opposition?

LOGIC EXERCISES

Choose from the following statements pairs of contrary, contradicting, subordinate and subcontrary sentences:

1. Some of the elements are known.
2. None of the elements is known.
3. All elements are known.
4. Some of the elements are not known.
5. All material substances have gravity.
6. None of material substances has gravity.
7. Some of material substances have gravity.

Find contrary and contradicting statements:

8. All people followed him.
9. All birds are feathered.
10. None of reptiles is feathered.
11. Static stars are self-luminous.
12. Not many people know themselves.

Make all possible oppositions to the statements:

13. All is good what ends good.
14. Honesty is the best policy.
15. Some good deeds are not rewarded.
16. None of knowledge is useless.
17. Some of stars are visible.

Which statements can be made by accepting the truth of the statements:

18. All what is complex is destroyable.
19. None of idlers deserve praise.
20. Some of plants are harmful.
21. Numbers are value.
22. Some of substances are not complex.

What statements can be made by accepting the falseness of the statements:

23. Some of animals are rational.
24. Some of lies don't deserve blame.
25. All sciences are performed with the help of experience.
26. None of parallelograms is equilateral.
27. Some of changes have no reason.
28. Some of equiangular triangles are equilateral.

Topic 10. ABOUT LAWS OF THINKING

The notion of law of thinking

Laws of thinking are such laws, which our thinking should obey to be logical, i.e. to be true. If we say that there are such laws which our thinking should obey to be true it seems to a lot of people, that it is only necessary to know in what consist these laws, and to apply them in the process of thinking to avoid the mistakes of thinking. But such an opinion is absolutely unjust, because so called laws of thinking are not the substance laws, which we should apply consciously, purposely, but these are laws, which we use unconsciously.

Since the intentional laws` of thinking use is impossible, then many people think, that these laws are of no practical importance for our thinking. In their opinion, they could only be of importance in that case, when we could use them to achieve the truth, and if they cannot serve this purpose, they should be rejected as absolutely useless.

To determine a real laws` of thinking importance we should recollect what was said above about the difference between psychology and logic. We saw that psychology as all natural sciences is aimed to describe the processes of thinking in such a way they take place in reality. In this sense a natural science forms general provisions, which are called decrees of nature; in the same way psychology forms general provisions, which serve to express the process of thinking, and these general provisions may be called the laws of thinking. Logical laws of thinking do not make their aim to show how thinking should take place, which leads to achievement of the truth. That is why the laws of thinking should not be called from the point of view in which a decree of nature is usually called a law, exactly as formulating of that, which happens practically, but they are substance laws in the sense that they represent well-known **requirements which our thought should obey;** the thought should follow these requirements to be true.

Usually four laws of thinking are acknowledged, namely: "law of identity", "law of contradiction", "law of excluded middle" and "law of sufficient reason".

Law of identity. The law of identity can be formed in such a way: **"A is A", i.e. every object is that what it is.** At first sight it seems that this formula contains something self-evident, and that is why something

that practically has no value. In fact this law contains a very important requirement, namely in the process of our thinking every thinkable thing or idea of thinkable thing, which we denote symbolically with the help of **A**, to keep its identity. If in our thinking appears the idea of any thing (**A**), then in further processes of thinking it should be thought with the same content, with which it was thought in the beginning.

That what we are thinking at the present moment about this or that thing we should think further, i.e. we should think with the same content, with which we were thinking before. The logical thought won`t be realized, if I having said that **A** is **B**, at repeating this judgement I won`t think about **A**, but about another thing. For example, if expressing judgement "kitchen salt consists of chlorine and natrium", I am thinking about kitchen salt, and at repeating of the judgement I will think about other salt, the process of thinking will lead me to false results. It is necessary for me at repeating the judgement "kitchen salt consists of chlorine and natrium" to think exactly about kitchen salt, but not about any other salt. It is necessary for every thinkable thought in the process of thinking to be identical with itself. Without observing this requirement the logical thinking, i.e. true thinking cannot be realized.

So, according to the law of identity all that we think should be identical with itself. This law is applied mainly to notions and ideas. In the process of thinking they should remain identical with themselves, otherwise the accuracy of thinking will be broken.

When we start joining ideas, in other words when we start judging, there is a necessity to apply other three laws, namely: law of contradiction, law of excluded middle and law of sufficient reason.

Law of contradiction. The law of contradiction is formed in such a way: " **A can`t be at one and the same time B and not-B**", or " **from two judgements, one of which affirms the thing that the other denies, one judgement must be false**". The meaning of this law consists in that, that nothing can have conflicting qualities at one and the same time and in one and the same respect. For example, we cannot imagine by no means, that paper at one and the same time is white and not white, for example red. We cannot imagine by no means, that the house is big and not-big at one and the same time. None of the quality can be present and absent at one and the same time.

Thus the law of contradiction demands from us not to attach conflicting predicates **B** and **not-B** to one and the same thing, at one and the same time and in one and the same respect.

Law of excluded middle. The law of excluded middle is formed in such a way: **"When we have 2 judgements, one of which affirms that, what the other denies ("A is B" and "A is not-B"), it cannot be the third, middle judgement").**

The best of all would be to explain the law of excluded middle, when we say that according to this law, we can only affirm about every quality of a thing, whether it belongs to this thing or not; in that case it cannot be nothing third, middle; something is excluded in that case. Attaching any predicate to any thing, we can attach only *B, or not-B.* The thing must be either black, or not-black. The plants can be either coniferous, or not-coniferous; animals can be either vertebral, or not- vertebral, it cannot be nothing third (*tertium non datur*).

Law of sufficient reason. The fourth law of thinking is called the "law of sufficient reason"(lex rationis sufficientis). This law is formed in such a way: **"We all must think with sufficient reason",** i.e. every thought, every judgement must have definite logical substantiation. If we have a judgement and its truth is not directly evident for us, then we must find a reason (ratio) for this judgement, we must substantiate it logically. But what is logical substantiation?

When we examined conditional judgements, we saw what is called reason and what is called corollary, that is why we must understand, what means that **"a thought must have certain substantiation"**. We have seen in the first chapter that all regulations must be brought to directly evident regulations. Such reduction presupposes, that there is such a connection between judgements, that some judgements lean on the other, they are substantiated by the other. For example, if we say that "the weather will change", because the barometric pressure falls, then the judgement" the barometric pressure falls" is a reason for the judgement "the weather will change". If we find, that "the triangle has two different sides", then this judgement is a reason for the judgement "two angles of this triangle are equal".

Usually in logic a reason and a cause are marked by one and the same term *ratio,* but only the reason is called *ratio cognoscendi* ("reason of cognition"), and the cause is called *ratio fiendi* ("reason of formation"). The difference between these two ratios will be shown by the example. I say a judgement: "It became warmer in the room". The logical substantiation of this judgement can be in judgement: "mercury of the thermometer became widened". A causal substantiation of the warmth in

the room will result in that case, if we say “a stove was stroked, that’s why it became warmer in the room”.

Formal character of laws of thinking. Laws of thinking, which were examined above, have the same meaning in logic, which axioms have in mathematics. They are also directly evident, as the latter, as for example the axioms: “integer is more than part”, “ between two dots only one straight line can be drawn”.

These laws are also called **formal** laws of thought, because they don’t touch thought’s content. The law of identity doesn’t point out, namely what ideas, notions, judgements remain identical. The law of contradiction also doesn’t point out, what thoughts must not contrary to themselves. The law of excluded middle says nothing about, between what contradictory judgements can’t be the third one. These laws don’t say this, because their affirmation is right to every idea, to every judgement: every thought must obey these laws, absolutely in such a way, as algebraic formulas don’t show, as applied to what numbers they are right, and exactly because any numbers and values can be put in them.

Questions for revision:

1. What is the laws of thinking?
2. What kinds of laws of thinking exist?
3. How is the law of identity formulated?
4. How is the law of contradiction formulated?
5. Explain the law’s of contradiction use.
6. How is the law of excluded middle formulated?
7. Explain the law’s of excluded middle use.
8. How is the law of sufficient reason formulated?
9. What is the difference between reason and cause?
10. Why are the laws of thinking called formal laws?

Topic 11. ABOUT IMMEDIATE INFERENCE

Inference`s definition. Now we can examine inferences, or reasoning, which is the most absolute logical construction. An inference results from judgements, and in such a way, that a new judgement is derived with a necessity from two or more judgements.

Thus, **an inference is a judgement`s derivation from other judgements**, which in such a case are called sumptions or assumptions (praemissae). In general, an inference is a comparison of sumptions` row. But there is a kind of inference, which is based on one sumption; these are so called inferences in non-intrinsic sense, or immediate inferences. For example, a judgement: "none of metals isn`t a compound body". We can draw a conclusion from such a judgement, that "none of
compound bodies isn`t a metal". This is an immediate inference. It`s an inference, because, having supposed one judgement, we derive another one from it.

Depending on number of sumptions inferences fall into 2 groups:

1) inferences in non-intrinsic sense, or immediate inferences;
2) inferences in the true sense.

To the latter group belong such kinds of inferences:

1) **induction**;
2) **deduction**;
3) **analogy** etc.

Immediate inferences. Immediate inferences fall into the following groups:

I. Inferences about contrast, which in their turn are divided into:

1. *Inference from subordinating to subordinate* (ad subordinatam). If there is generally-affirmative judgement, for example "all people are subjected to errors", from its truth we conclude the truth of partially affirmative one: "some people are subjected to errors". We can easily see that this is an inference from subordinating judgement to subordinate judgement. We have

examined the case of inference form **A** to **I**; inferences from **E** to **O** also belong to this group.

2. *Inference from subordinate to subordinating* (ad subordinantem). For example, we have a partially-affirmative judgement "some horses are carnivores". From its falsity we conclude the falsity of generally-affirmative judgement: "all horses are canivores".
3. *Ad contradictoriam* **(A-O, E-I)** From falsity of generally-affirmative judgement: "all people read newspapers", we conclude the truth of partially negative one: "some people don`t read newspapers". Such a relation is possible between judgements **E** and **I**. (Enumerate, what cases of inference ad contradictoriam are possible.)
4. *Ad contrariam* **(A-E)**. From the truth of generally-affirmative judgement "all plants are organisms" we conclude the falsity of contrary judgement: "none of plants isn`t an organism". There are two cases of ad contrariam inference: from the truth of **A** to falsity of **E** and from the truth of **E** to falsity of **A**.
5. *Ad subcontrariam* **(I-O)**. A partially-affirmative judgement is given: "some people are omniscient". From the falsity of this judgement we conclude the truth of partially negative one: "some people are not omniscient".

The second group of immediate inferences, which are formed by the change of judgements, is called obversion.

II. **Obversion** (obversio).This process consists in the change of the judgements` form: affirmative judgements turn into negative, and vice versa. The sense of judgement doesn`t change.

For example, this judgement in affirmative form: "these pupils are assiduous". This judgement can be turned into equivalent to it negative judgement. We must put negation before copula and predicate for this. Then we`ll have a judgement: "these pupils are not not-assiduous".

A negative judgement turns into equivalent to it affirmative one by that, that the negation is transferred from copula to predicate. For example, "the pupils are not assiduous". The obversion of this judgement gives an affirmative judgement: "the

pupils are not-assiduous". The second judgement is said to be a derivation from the first one.

There are some examples of obversion of some judgements into other.

A obversion. A judgement **A** "all metals are elements" turns into judgement **E**: "all metals aren`t not-elements", or "none of metals isn`t not-element", or "none of metals is not compound body".

E obversion. A judgement **E** "none of people is not perfect" turns into judgement **A**: "all people are not perfect".

I obversion. A judgement **I** "some people are reliable" turns into judgement **O**: "some people aren`t not-reliable".

O oversion. A judgement **O** "some people are not reliable" turns into judgement **I**: "some people are not-reliable".

Thus, we see that there is a certain law of some judgements` obversion into other: **A** always turns into **E**, **E** into **A**, **I** into **O**, **O** into **I**.

General scheme of obversion

A All S are P	**E** None of S isn`t not-P.
E None of S isn`t P..	**A** All S are not-P.
I Some S are P..	**O** Some S are not not-P.
O Some S are not P…	**I** Some S are not-P.

The third group of immediate inferences is conversion.

III. **Conversion** (conversio). In this process the transference of subject on the predicate`s place happens, and vice versa.

Let's try to convert judgement A "all birds are animals" by mentioned method. Then we'll have judgement "all animals are birds", but it is not true, because fish and mammal also enter this class. Consequently, there are animals, which are not birds. The mistake in this conversion happened in consequence of that thing, that the circumstance wasn't taken into consideration, that predicate in generally-affirmative judgements is not distributed, and therefore by conversion the predicate shouldn't be taken in the whole volume. That's why the judgement "all birds are animals" converts to judgement "some animals are birds". We can make clear the necessity of predicate`s quantity changing in the process of

generally-affirmative judgement`s conversion with the help of the scheme, which can show subject and predicate volumes` connection. The subject "birds" (S) constitutes only a part of prediate`s P volume; that`s why by converting, the predicate must not be taken in its whole volume. Such a conversion, when a judgement changes its quantity, is called **conversion by means of limitation (conversio per limitationem** or **per accidens).** In such a way, the judgement A converts to I.

But when the subject and the predicate of generally-affirmative judgement are equivalent notions, i.e. they have equal volume, then the judgement after conversion keeps its quantity; then the conversion is said to happen purely. For example, the judgement "all monkeys are four-handed" converts to judgement "all four-handed are monkeys". Such a conversion is called **simple**, or **pure conversion (conversio simplex).**

Judgement I converts purely. For example, the judgement "some metals are precious" converts to judgement "some precious materials are metals".

Judgement E also coverts purely. For example, the judgement "none of honest witnesses isn`t vendible" converts to judgement "none of vendible persons isn`t an honest witness".

Judgement O: "some people are not rich" by conversion could lead to "all rich are not people". But it can`t be, because in converted judgement the predicate is being taken in the whole volume, while in the converting judgement it was not taken in the whole volume. Partially-negative judgement can`t be generally converted, and namely because in converted judgement must be negative judgement, consequently the predicate in it must be distributed, while in converting judgement as a subject of particular judgement it is not distributed.

This theory is occasionally said to be unimportant, but in reality it is of practical use. By converting generally-affirmative judgements we always aspire to convert them without limitation. When we say: "all great people have big skulls", then there is a tendency to think so, that "all people, who have big skulls, are great people".

IV. **Opposition**. The fourth group of immediate inferences is called opposition. This, in fact, is a joining of obversion with conversion. In the process of opposition at first we turn any judgement, and then we convert a turned judgement. There is a judgement **A**: "all metals are elements". Let`s make an obversion, then we`ll have: "all metals are not not-elements". Converting this judgement, we`ll have **E**: "all not-elements are not metals", or "all compound bodies are not metals".

Let`s take opposition of generally-negative judgement **E** "none of lazy persons are not worth success". This judgement turns into the judgement: "all lazy persons aren`t worth success". This judgement in its turn by converting gives: "some people, who are not worth success, are lazy persons". Finally, let`s take the opposition of partially-negative judgement **O**: "some unjust laws are not withdrawn". This judgement turns into **I:** "some unjust laws are not-withdrawn laws"; and this judgement by converitng gives: "some not-withdrawn laws are unjust". The judgement **I**, obviously, doesn`t allow opposition.

Table of opposition

A All S are P	None of not-P is not S
E None of S is not P	Some not-P are S
O Some S are not P	Some not-P are S
I Some S are P	

Questions for revision:

1. What is an inference?
2. What kinds of inferences do we distinguish?
3. What is an immediate inference?
4. What inferences are called subordination inferences?
5. What inferences are called contradiction inferences?
6. What is obversion?
7. How the judgements A, E, I, O are turned?
8. What is conversion?
9. How the judgements A, E, I, O are converted?
10. What is opposition?

Topic 12. DEDUCTIVE CONCLUSIONS. SYLLOGISM

The definition of syllogism. We have examined direct inferences, and now we will investigate indirect inferences, and first, we'll investigate deductive inferences. Deductive inferences take a shape of syllogisms. Syllogism is the form of inference, where surely of two conclusions comes out the third. However, one of two given conclusions is either general affirmative or general negative. Syllogism is an inference out of general. The obtained conclusion, by no means, would not be more general, than conclusions from which they are deduced.

For instance, there are two conclusions: **All plants are organisms.**
Pines are plants.

Hence, "pines are organisms".

These example shows that if we are given two conclusions, surely, out of them, appear a new one. We don't pass on, if these conclusions true or not, though accepting them, we admit a new conclusion.

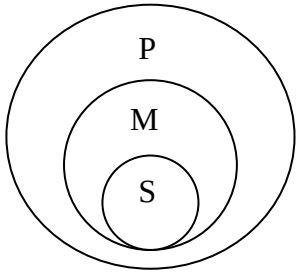
Components of syllogisms. Given judgments are called premise or praemissa, and a new conclusion, that comes out of premise's juxtaposition is called conclusio. Those notions, that comes to conclusio and premise, are called termini. Subject conclusio ("pines") is called smaller term (terminus minor), predicate conclusio ("organisms") is called a major term (terminus major), and term ("plant"), that is not included to conclusio, is called middle term (terminus medius).

The denotation of terms big or small is depending on their content in one of typical cases syllogistic inference, as in earlier given example. The biggest content fall at predicate ("organisms"), the smallest one – at the middle term ("plants"), that doesn't include conclusio.

It comes out visually, if reflect schematically the relation between the terms. Where **S** means term, **M** – middle, **P** – big.

The middle term is called so, because it serves as intermediate, binding element between the bigger and the smaller terms. The middle term serves to comparison the bigger term with the smaller one, whereas themselves, they can't be compared. The comparison is possible by means of middle term. We wouldn't bind the term "pines" with the term "organisms", if we hadn't the term "plants" that serves as a binding agent between the terms "pines" and "organisms".

Conclusion that include a major term, is called a major premise; conclusion, that include a minor term, is called minor premise.



Form and content of syllogism. In syllogism one should know how to distinguish content from form. Content is terms, which are obvious. And form is a connection, we mean by the term of premise. In syllogism we may pay no attention to the truthfulness or falsity of premise. It is only important to make a right conclusion, to commit a true inference, to bind properly one bigger inference to the smaller one, and that is the form of syllogism. Therefore, sometimes premise can be false, but the conclusion after all will be true, as one can see in the following syllogism, the premises of which consist of obvious false conclusions:

Lions are herbivorous.
Cows are lions.
Cows are herbivorous.

Principle of syllogism. Syllogistic conclusion is that, when we accept premises, then necessarily comes out the conclusion. But why is that going on, when having these known premises the conclusion necessarily comes out? Such a relation between the premises and the conclusion is explained by the following state: " if one thing is in the second one, and that the second is in the third one", or "when one thing is in the second one, and this second is out of the third, then the first thing is too out of the third one". This regulation, that is called the principle of syllogism is easy to perform.

If A is in B, and B is in C, then, consequently, A is in C. Further, if A is in B, but B is out of C, then A is too out of C.

The most general formula of this principle in logics is called *dictum de omni et de nullo*. The meaning of this principle is in the following:

Everything, which is confirmed due to the whole class, is confirmed either due to every thing, which contains this class, and vice versa: everything, that is denied as to the whole class, is denied as to everything, what this class contains. This state is called principle, because it is obvious; and it is called the principle of syllogism because it is the basis of important deduction of syllogism from the known premises.

The rule of syllogism. Let's consider which rules we have to follow when constructing syllogism, to make it right or, in other words, syllogism must meet the conditions in order to make the conclusion right.

1. ***In every syllogism must be neither less nor more than three terms.*** If there's more than three terms, there'll be no any syllogistic connection. If we take such an example:

All orators are conceited.
Cicero was a statesman.

We see that in these two conclusions, there are four terms, but no inference here can be made. If the second conclusion is as following: "Cicero – orator", so the inference will be defined, because then, in syllogism, there'll be three terms.

Sometimes, there are four terms in syllogism, but at first sight it seems that there're three. It goes this way as a result of ambiguity of terms. For instance:

Bow is a weapon of savages.
This plant is an onion.
This plant is a weapon of savages.

The mistake in this case made because the middle term in a major premise is used in the other sense than it is used in the a minor premise. Thus, in syllogism, instead of three terms there're four. Such an inaccuracy is called quarternio terminorum.

2. In every syllogism there'll be neither more nor less than three conclusions.

This according as there can be only three conclusions when there're three terms. If there're three terms, two of which include some conclusion, and one the same pair of terms doesn't recur, it is clear, that when having three terms, we can get only three conclusions.

3. The middle term must be taken at least in one of the premises totally.

There's an example to explain this rule:

All the French are Europeans.
All the Parisian are Europeans.

Out of these two premises one can make no any inference. But if we have taken the middle term at least in one premise totally, then we could make an inference. For example:

All the French are Europeans.
All the Europeans are literate.
Therefore, all the French are literate.

And one more example:

All naturalists are observant.
N is observant.
Therefore, N is naturalist.

However the term "observant" is not taken in its volume, beside the naturalists, the group "observant" can include also historians, and others. So, N can be observant and at the same time be out of naturalist's group, as shown in the scheme (***fig. 20***).

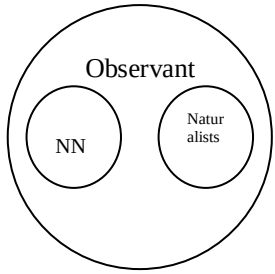


Fig. 20

If it was said :

All observant people are naturalists.
N is observant.
Therefore, N is naturalist.

Then, this inference would be right.

In first case, the middle term wasn't taken in its all volume in any of the premise. That is why there is an ambiguity. When go deeper, anyway, it is possible that once we can take one part of the middle term, and then once – another part, as it is on the scheme.

Whereas the middle term is taken once in its all volume, then we would have the same in small and a major premise.

But if the middle term is taken at least in one premise in its all volume, then, there's obvious the thing, that binds the major term with the small one. But if the big pramissae, or the small one in its all volume doesn't include it, so it cannot function as a connecting link. In this rate, the big or the minor term refer to something uncertain, ambiguous, as it was already mentioned earlier. N can in be in the group of naturalists, and it can be out. Therefore, no any certain inference can be made. That's why the middle term, at least in one of the premise should be taken in its all volume.

4. ***The terms, which were not taken in all their volume in the premise, and in the conclusion also cannot be taken in all volume***.

There is an example to explain this rule:

All criminals deserve punishment.
Some Englishmen are criminals.
All Englishmen deserve punishment.

The obvious mistake in this syllogism appears as a sequence of taking the term "Englishmen" in all volume, when this term in the premise wasn't taken in all volume. We would make a right conclusion, if we said: "some Englishmen deserve punishment".

Let's take another example, where mistake isn't so obvious:

All historians are impartial.
Naturalists are not historians.
Naturalists are not impartial.

To know whether this conclusion right or not, let's express the syllogism symbolically (***fig. 21***)

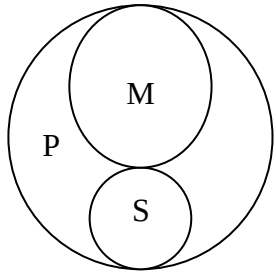


Fig. 21

Historians (M) are in P (impartial). The naturalists aren't said to be historians.

We, consequently, cannot put it in the circle M. That's why the naturalists we can put anywhere, except for the circle M, but if so, then putting S out of M, we can put it anyway in the circle P. Owing to this, it is possible that "naturalists are impartial". In a major premise the term "impartial" isn't taken in all volume, so that historians can include only the part of those, who are impartial, and

that's why we cannot exclude them out from the list of impartial people and naturalists. The mistake in this syllogism was made because in the major premise the term "impartial" as a predicate of general judgment isn't taken in all volume. But in the conclusion, that is the predicate of general negative conclusion, it is taken in full volume. In other words, once we talk not about anybody and then we talk about everybody. Such a mistake is called illiciti processi, - inadmissible extension of the major term as in the given example; inadmissible extension of minor term we had in the first example.

5. We cannot bring out any conclusion out of two negative judgments.

Let's explain the rule with such an example:

Chemistry is not the humanities.
Mathematics is not chemistry.

What comes out in these premises? We mark (***fig. 22***) "chemistry" as M, "humanities" – P, "mathematics" – S. M must be out of P, and S – out of M. As we see, the middle term in this syllogism doesn't bind the major term, because it is out the big and the minor term. If M isn't bound to P, and S isn't bound to M, then S cannot be connected to P, that is through the middle term one cannot set no any connection between the big and the minor term.

6. If one of the premises is negative, then the conclusion also may be negative, and vice verse, for obtaining the negative conclusion it is necessary that one of the premises is negative.

Here is an example:

No any M is P.
All S is M.

P is out of the middle term ***M***, then ***S***, that is in ***M*** wouldn't bind ***P***. Hence comes a negative conclusion.

Thereby, if we have two premises, one of which is negative, then we cannot make an affirmative conclusion.

7. There is no any conclusion follows out of two particular propositions.

It becomes clear from the preceding rules. Suppose that these particular propositions will be **I** and **I**, then it turns out that the

middle term in both premises won't be distributed as subject and predicate of general affirmative conclusion. If we try to deduce, we will depart from the third rule. Actually, let these premises look like:

Some M are P.
Some S are M.

In these both judgments the middle term isn't distributed. That's why the conclusion is not necessary. Consider judgments I and O, for example:

Some M are P.
Some S are not M.

However here one of the premises is negative, then the predicate P conclusion must be distributed. Moreover, in the given premises P as a predicate of the general affirmative judgment is not distributed. Consequently, an attempt to make a conclusion would break the 4th rule.

8. If one of the premises is a particular proposition, then a conclusion also should be particular.

If we want to get a general conclusion, then one of the premises in the syllogism is particular, that is breaking 3d and 4^{th} rules.

Suppose, we have a syllogism:

All M are P.
Some S are M.
All S are P.

In this syllogism, the 4^{th} rule is broken.

There's another syllogism:

Some M are P.
All S are M.
All S are P.

In this syllogism the 3rd rule is broken.

Questions for revision:

1. How we define a syllogism?
2. What parts in syllogisms are distinguished?
3. What is the difference between from and content of syllogism?
4. What is the essence of the syllogisms principle?
5. Specify the rules of syllogism and explain them with the help of examples of their usage.

Topic 13. SYLLOGISM. FIGURES AND MODI OF SYLLOGISM

Possible combinations of judgments in syllogism. In the previous theme we've examined the conditions of accuracy of syllogisms. So let's consider now the supplements to these rules in the following examples. Let's take three judgments that can be syllogisms. These judgments must be either ***A, I, O***, or E. It is clear that to make syllogisms they can be combined in the very different ways. For example we can have a combination of judgments ***AAO, EAI*** and so on. Using the rules, we should examine which combinations or connections can give true syllogisms.

To know which combinations give true syllogisms, we should decide for ahead which combinations here are possible in general. For this we do the following. We take the combinations ***AA, AE, AI, AO*** four times and add to these combinations ***A, E, I, O,*** so we get:

AAA or **AEA** or **AIA** or **AOA**
AAE » **AEE** « **AIE** » **AOE**
AAI » **AEI** » **AII** » **AOI**
AAO » **AEO** » **AIO** » **AOO** etc.

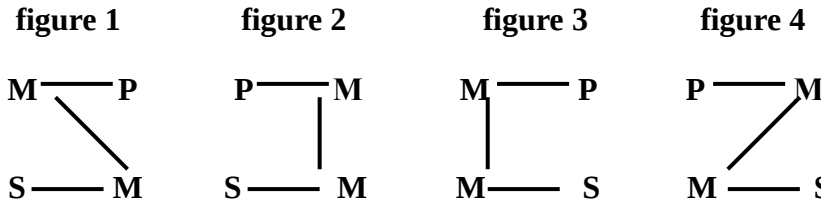
Thus, we can get 64 possible combinations. With this table of combinations, we examine, following the rules, which of these combinations we should reject, as those, which don't correspond the rules, and which combinations should remain, as those, which give true syllogisms.

The first combination ***AAA*** goes with all eight rules. Combination ***AAE*** is wrong according to the 6th rule, because there is a negative judgment ***E*** in the conclusion, and to make it possible, it is necessary, that one of the premises was a negative judgment, meanwhile, in our syllogism ***AAE*** both premise are positive. Consequently, the given combination is impossible.

Combination ***AAO*** is wrong according to the 6th rule, because the conclusion is negative, whereas the premises are affirmative.

If examine all 64 combinations this way, then we have only 11 combinations, which give true syllogisms. These combinations are: ***AAA, AAI, AEE, AEO, AII, AOO, EAE, EAO, EIO, IAI, OAO.***

We undertake a task to solve the question, which judgments can be combined to give true syllogisms. We solve the known question in its proper way, but in fact it isn't so, because when creating the combinations its compulsory to think over the state of the middle term in premises. In that syllogism, which we've examined since then, the middle term in major premise is subject, and in the minor premise – predicate. But we can set the middle term in free condition: we can make the middle term a subject in both premises, or a predicate in both premises, or finely, subject in major premise and predicate in minor premise. Due to this we have so called four figures of syllogisms, which are depicted on the given diagram.



This diagram gives a opportunity to keep the state of the middle term. The horizontal lines connect premises, and sloping and vertical lines connect the middle term in both premises. If pay attention to that fact, that the sloping and the vertical lines, that bind the middle term, are located symmetrically, so the state of middle term is easy to remind.

Figures and modi of syllogism. In figure 1 the middle term is subject in major premise, and predicate in small one. In figure 2 it is predicate in big and minor premises. In figure 3 it is subject in big and minor premises. At last, in figure 4 it is predicate in major premise and subject in minor premise.

Let's take 11 possible combinations and suppose, that every combination change the state of the middle term due to mentioned 4 rules. As a result, we've got 44 combinations.

Let's see, which of them are possible. To show how this kind of investigation carries out, we take as an example combination ***AEE*** and depict it in the first figure.

A All M is P.
E No S is M.
E No S is P.

If we pay attention to the term ***P***, then we find that, it isn't distributed in major premise as predicate of general affirmative judgment, where in the conclusion as a subject of general negative judgment it is distributed. It is wrong due to the 4th rule, and consequently, this combination is not possible. Consider further, how this combination may be as to the figure 2:

A All P are M.
E No S is M.
E No S is P.

Here are all rules of syllogisms observed and thus the conclusion is true. But we examine this conclusion on the figure 3, the conclusion will break the 4th rule. Syllogism will be like:

A All M are P.
E No M is S.
E No S is P.

On the figure 4 this combination will be true.

If we investigate all 44 combinations by the mentioned way, we'll have the following 19 proper types of syllogisms, or modi, distributed on the figures.

figure 1	*figure 2*	*figure 3*	*figure 4*
AAA	**EAE**	**AAI**	**AAI**
EAE	**AEE**	**IAI**	**AEE**
AII	**EIO**	**AII**	**IAI**
EIO	**AOO**	**EAO**	**EAO**
		OAO	**EIO**
		EIO	

Everyone who studies logics have to know by heart all modi. To the learning easier, there's a poem, written in hexameter:

Barbara, Celarent, Darii, Ferioque prioris;
Cesare, Camestres, Festino, Baroko, sekundae;
Tertia, **Darapti, Disamis, Datisi, Felapton**,
Bokardo, Ferison habet: Quarta insuper addit
Bramantip, Camenes, Dimaris, Fesapo, Fresison.

Here every word in bold means separate modus, premises and conclusion of which is easy to define, if we find vowels. For example, **Barbara** means modus figure 1, in which both premises and the conclusion is ***AAA***; **Celarent** means modus ***EAE***. The meaning of the rest letters of these words is set below.

There are examples that illustrate figures and modi.

Figure 1. **Barbara**

A All predatory animals eat meat.
A Tigers are predatory animals.
A Tigers eat meat.

This syllogism can be depicted symbolically as: "Predatory animals" as a middle term is marked ***M***, "those, that eat meat" as big term – ***P***, and "tigers" – ***S***.

Celarent

E No any insect has more than three pair of legs.
A Bees are insect.
E Bees have no more than three pair of legs.

Darii

A All predatory animals eat meat.
I Some domestic animals are predatory animals.
I Some domestic animals eat meat.

Ferio

E No one of diminished responsibility is punished.
I Some criminals are of diminished responsibility.
O Some criminals are not punished.

Figure 2. **Cesare**

E No any of fair mam is envious.
A Every ambitious man is envious.
E No any of ambitious man isn't fair.

Camestres

A Criminals work out of malicious intent.
E N didn't work out of malicious intent.
E N isn't a criminal.

Festino

E No any prudent man is superstitious.
I Some well-educated people are superstitious.
O Some well-educated people are not prudent.

Baroko

A All truly moral things are done for the right motives.
O Some things, which are beneficial for others, are not done for these motives.
O Some beneficial things for other people are not truly moral.

Figure 3. **Darapti**

A All whales are mammal.
A All whales live in water.
I Some animals that live in water are mammal.

This inference refers to the figure 3, where the middle term in both premises is subject. The small term "beings, which live in water" in minor premise isn't taken in its all volume; consequently, in the conclusion it shouldn't be taken in its all volume.

Felapton

E No any deaf-and-dumb can speak.
A Deaf-and-dumb people are morally normal people.
O Some morally normal people cannot speak.

Disamis

I Some novels are didactic.
A All novels are fictional stories.
I Some fictional stories are didactic.

Ferison

E No any unfair war can be justified.
I Some unfair wars were successful.
O Some successful wars cannot be justified.

Figure 4. Let's take a syllogism: **Bramantip**

A All metals are material things.
A All material things have gravity.
I Some bodies, that have gravity, are metals.

In this syllogism the middle term is taken as a predicate in major premise, and as a subject in minor premise. Predicate in minor premise isn't taken in its all volume, that's why in the conclusion it shouldn't be taken in its all volume. Thus, we have a conclusion: "Some bodies, that have gravity are metals". This figure is called by the of Gallen (III cent. A. d.); but Aristotle didn't have this.

And one more example to illustrate the 4th figure.

Camenes

A All squares are parallelograms.
E No any parallelogram is triangle.
E No any triangle is square.

Characteristic of figures. Let's characterize in general all four figures of syllogism in relation of their cognitive meaning.

Figure 1. In it minor premise is affirmative, and big one is general. This figure is used in cases, when it is necessary to show the usage of general states (axioms, laws of nature, principles of law etc.) to the particular cases. That is the figure of subjection.

Figure 2. In this figure one of the premise should be negative and major premise should be general. By means of this figure, false subjections and false deduction reject.

For instance, someone consider gas that is under test being oxygen. We have to indicate some features inherent to oxygen, which is not inherent that gas under test to make sure it is not oxygen. Now we have the following syllogism:

A Oxygen keep up the fire.
E This gas doesn't keep up the fire.
E This gas is not oxygen.

Someone can insist on that one individual has a fever, and insisting on this, he does submission. We need to reject this submission. Hence, we have the following syllogism:

A All patients that have fever feel thirsty.
E This patient don't feel thirsty.
E This patient has no fever.

Thus, in the 2d figure false submissions are rejected because one of the premise is negative. In jurisprudence verdicts are build up on this figure. For example:

A This fatal blow stroke a man of great power.
E Accused is not a man of great power.
E Accused didn't strike a fatal blow.

Figure 3. Here minor premise should be affirmative, and conclusion should be particular. So that in figure 3 imaginary identity of affirmative and negative judgments is always rejected or the exception out of general rule is proved. Suppose, we need to

prove that the statement " all metals are solid" allows an exception, so that is particular. So we build up a syllogism on figure 3.

E Mercury isn't solid.
A Mercury is a metal.
O Some metals aren't solid.

Figure 4 is artificial as a matter of fact and is not used.

The character of premises and conclusions of figures we can present graphically. Letters of modi of every figure we set on the vertical lines so that the letters of major premises will go with the first, letters of minor premises – with the second, and letters of conclusions will go with 3d horizontal.

Figure 1

b**A**r	cE**I**	d**A**	f**E**	All major premises are general
b**A**r	**A**	r**I**	r**I**	All minor premises are affirmative
A	r**E**nt	**I**	**O**	

Figure 2

c**E**	c**A**m	f**E**s	b**A**r	All major premises	One premise
s**A**r	**E**s	t**I**	**O**k	are general	is always negative
E	tr**E**s	n**O**	**O**	All conclusions are negative	

Figure 3

d**A**	d**I**s	d**A**	f**E**	b**O**k	f**E**	
r**A**p	**A**m	t**I**s	**IA**p	Ar	r**I**s	All minor premises are affirmative
t**I**	**I**s	**I**	t**O**n	d**O**	**O**n	All conclusions are particular

Questions for revision:

1. How is the difference between figures of syllogisms defined?
2. What figures of syllogism exist? What is the difference between them?
3. List the modi of all four figures.
4. What is the difference between figures due to cognition?

LOGIC EXERCISES

1. What syllogism rules are broken by the following modi not paying attention on the figure:
   AEI, AAE, IOO, IEO,AIA, EEO, AIO, OAI, III.

2. Check correctness of following modi:

AAA using figure2, ***EAE*** using figure3, ***AEO*** using figure4.

3. Check the same way ***AII*** using figures 2 and 4, ***AEO*** using figure 3 and ***IEO, IOO, AOE, EOO*** using all figures.

Examine given syllogisms below. If there is no conclusion, it is necessary to make a conclusion. If the conclusion was drawn, it is needed to examine whether it is true or not. It is also necessary to examine which figure and modi refer given syllogisms. If there's a mistake in syllogism, then it should be pointed out which exactly:

1. All sensible beings are animated.
All animals are sensible beings. Hence?
2. No any person can completely get rid of tastes of his time.
Artists are people. Hence?
3. Every fair person is noble.
Some scientists are fair. Hence?
4. All bodies, which have smaller density, than water, float on water.
All things of wood have smaller density than water. Hence?
5. All metals are electric conductors.
Copper is metal. Hence?
6. Everything, that gives a lifetime experience is useful.
Some mistakes give lifetime experience. Hence?
7. No any bribe taker is honest.
Some officials are bribe takers. Hence?
8. No any of ruminants has canines.
All lions have canines. Hence?
9. No any of flowering plants are breed by spores.
Fern breed by spores. Hence?
10. Phosphorus glows in the dark.
This substance doesn't glow in the dark.
Hence?
11. No any work of art should have sense of measure.
Some works of modern literature have no sense of measure.
Hence?
12. All gases are elastic.
Some substances aren't elastic.
Hence?
13. All metals are electric conductors.
Some bodies are not electric conductors.
Hence, some bodies are not metals.

14. No one who is brave is timid.
Every superstitious is timid. Hence?
15. All right flat figures can be entered to the circle.
Some parallelograms cannot be entered to the circle.
Hence?
16. All planets are round.
Wheel is round.
Wheel is a planet.
17. Every fair person diligently does his work.
This person diligently does his work.
Hence, this person is fair.
18. Some cars are important for farming.
All cars are physical devices. Hence?
19. All parallelograms are quadrangles.
Some parallelograms are equilateral figures. Hence?
20. All birds gives eggs.
All birds are vertebrates.
Some vertebrates gives eggs. Hence?
21. Some works of people are not attractive.
All works of people are artificial production. Hence?
22. Turpentine oil doesn't run through the current.
Turpentine oil is liquid. Hence?
23. Some pieces of grief are useful.
All pieces of grief are unpleasant.
Hence, some unpleasant things are useful.
24. All spiders are arthropods.
All spiders have four pairs of legs. Hence?
25. Some great acts remain almost unknown.
All great acts are heroic deeds. Hence?
26. All diamonds are pure carbon.
Some diamonds are precious. Hence?
27. Ostriches cannot fly.
Ostriches are birds. Hence, some birds cannot fly.
28. Some religions do not admit polygamy.
All religions sanctify marriage. Hence?
29. There's no plant, that can live without water.
Some plants live in desert. Hence?
30. All types of fish breathe with gills.
All animals, which breathe with gills, live in water.
Hence, some animals, which live in water, are fish.

31. All snails are mollusks.
No any of mollusks is mammal. Hence?
32. Some beings, that look like plants are corals.
All corals are animals. Hence?
33. No any of fair men resort to lie.
Those, who resort to lie, delude others. Hence?
34. No any ignoramus is connoisseur of art.
Some connoisseurs of art are musicians. Hence?
35. Some verities that effect people's behavior are speculative.
All verities that effect people's behavior have value. Hence?
36. Every good state leader think well of progress,
Some members of parliament think not well of progress. Hence?
37. No any section of science can lead to perfection.
All sections of science are worth development. Hence?
38. Ugliness of face is a natural shortage.
Clumsiness is not a natural shortage.
Clumsiness is not an ugliness of face.
39. Some mineral compounds don't decompose of warmness.
All organic substances decompose of warmness. Hence?

Make up syllogisms from the following sentences:
a) Some habits deserve rebuke, as they become a passion.
b) Virtue is not a folly, because it ennoble person.

Amplify syllogisms due to the 2d figure in the following judgments:
a) A man that is obsessed with passion possesses no character, because he cannot control himself.
b) Some people that live according to the law, do not possess moral temper, because they carry out legal thing, without correspondent mood.

Prove the following statements:
a) Whale is not a fish.
b) Hun is not a civilized people.
c) A tree doesn't sink in water.
d) Some books mustn't be recommended.
e) Some birds don't fly.
f) Some novels are useless.
g) Some simple machines are used in domestic work.
h) Some pleasant societies badly effect our character.

Topic 14. REDUCTUM OF SYLLOGISM FIGURES

We have seen that there exist different figures and moods of syllogisms. One would like to know if they are equivalent. Is there any difference if we will deduce by a figure 1, by a figure 2, or by a figure 3? It turns out that no, therefore, it is necessary to give a preference to moods of figure 1. Proofs by this figure have especially obvious character. For verification of validity of syllogism conclusion expressed through any mood of one or another figure, this mood should be reduced to any mood of figure 1, because evidence of conclusion by a figure 1 can be proved by showing the axiom of syllogism applicability to moods of figure 1. There is an indication on how this reductum must be applied to moods of figure 1 in symbolic denotations of moods which we talked about in a preceding chapter,

The letter **s** shows that the proposition, marked by preceding vowel, must be exposed to the pure reversion (conversio **s**implex**).** The letter **p** shows that the proposition, marked by preceding vowel, is needed to be conversed **p**er accidens, or by means of limitation. The letter **m** shows that the premises of syllogism need to be moved, i.e. the major premise needs to be made minor in new syllogism, and minor needs to be made major (it is necessary to perform **m**etathesis or **m**utatio praemissarum).

The initial consonants of the names **(B, C, D, F**) show the moods of figure 1, received by reductum. So **C**esare, **C**amestres and **C**amenes of figures 2 and 4 can be converted to **C**elarent of figures 1; **D**arapti, **D**isarms of figure 3 can be converted to **D**arii, **F**resison – to **F**erio**.**

Letter **k** shows that this mood can be proved through any mood of figure 1 with the help of the special method which is called reductio per deductionem ad impossibile, or, shorter, reductio ad impossibile. This method of reductum is also called reductio ad absurdum.

Let's consider a few examples of reductum.

Cesare mood of figure 2, as an initial letter shows, is reducted to ***Celarent*** mood of figure 1. The letter **s** in denotation of this figure shows that in proposition **E** it is necessary to make a simple conversion. Reductum ***of Cesare*** to ***Celarent*** can be made clear through comparison of charts of these moods.

Cesare is reducted to ***Celarent.***

E Not a single *P* is *M*.	**E** Not a single *M* is P.
A All *S are M*.	**A** All *S* are *M*.
E Not a single *S* is P	**I** Not a single *S* is P.

From comparison of charts it is evidently seen that only pure reversion took place in a major premise.

Darapti mood is reducted to ***Darii*** of figure 1 and exactly the following way. A minor premise needs to be reversed by means of limitation, i.e. the proposition «all *M are S*» must be turned into the proposition «some *S* are *M*».

Darapti is reduced to ***Darii***

A All *M* are P.	**A** All *M* are P.
A All *M* are S.	**I** Some *S* are *M*.
I Some *S* are *R*.	**I** Some *S* are P.

For example:

Darapti	***Darii***
A All whales are mammals.	**A** All whales are mammals.
A All whale are water animals.	**I** Some water animals are whales.
I Some water animals are mammals.	**I** Some water animals are mammals.

Bramantip is reduced to ***Barbara*** by transposition of premises:

Bramantip	***Barbara***
All P are *M*.	All *M* are *S*.
All *M* are *S*.	All P are *M*.
Some *S* are *P*.	All P are *S*.

After a conclusion is done, the letter **p** specifies that it is necessary to make a reversion in it; then we will get: «Some S are *P*».

For example:

A All metals are material matters.	**A** All material matters are heavy bodies.
A All material matters are heavy bodies.	**A** All of metals are material matters.
I Some heavy bodies are metals.	**I** Some heavy bodies are metals. (After the reversion of per accidens)

Let's also consider the reductum ***of Camestres*** to ***Celarent***. For realization of such reductum it is necessary to make a transposition of premises, reversing a minor premise purely, and doing a pure reversion in conclusion.

Camestres	***Celarent***
A All P are *M*.	None of *M* is *S*.
E Not a single *S* is M.	All P are *M*.
E Not a single *S* is P.	Not a single P is S.
	Not a single *S* is P.

Lets consider an example:

A All stars are self-luminous bodies.	**E** Not a single self-luminous is a planet.
E Not a single planet is a self-luminous body.	**A** All of stars essence self-luminous body.
E Not a single planet is a star.	**E** Not a single planet is a star. (After a pure reversion.)

Reductio ad absurdum. At last, let's consider another method of reductum, namely reduction by means of reductio ad absurdum, an reductum to nonsense. It is used, as it was stated, in all of those moods in which a letter **k** is used.

Baroko and ***Bokardo*** belong to such moods. Letter ***B*** at the beginning of denotation shows that it is necessary to use ***Barbara mood*** for reductum. This method is called reductio ad absurdum (reductum to nonsense) because of the following reason. Having two premises, we come to the known conclusion. Someone asserts that our conclusion is incorrect. Then our task consists in showing the absurdity of this assertion. For this purpose we try to show that admitting these premises it is impossible not to admit our conclusion, or deduction.

Let's take deduction by ***Baroko*** mood:

A All P are *M*.
O Some S are not M.
O Consequently, some *S* are not P.

We will deny the truth of the conclusion: «Some S are not P». If we do not admit that the conclusion is valid, we must admit the validity of the contradicting proposition. Therefore, if is invalid that «some S are not P», than it must be valid that «all S are P». Having made the admitted statement a minor premise, as a letter $\mathbf{k}^1$ shows, we get the following ***Barbara*** syllogism with *P* as a middle term:

All P are *M*.
All S are P.
All *S* are *M*.

So, if we deny a primary conclusion, then we have to come to the conclusion that «all *S* are *M*». But this conclusion is in contradiction with a minor premise which was admitted to be validity. Thus, it is clear that, the one who objected us came to the contradiction admitting our premise but not admitting our conclusion. It means that we showed the absurdity of his objection, we showed his objection over of ad absurdum.

[1] It is ***κ*** that shows that premise, denotation of which precedes a letter, must be replaced by the statement, contradicting to a conclusion.

Let's also consider the example of ***Bokardo*** reductum through the application of reductio ad absurdum. The ***Bokardo*** scheme*:*

Some *M* are not P.
All *M* are *S.*
Some *S* are not P.

Denying the validity of the conclusion «some *S* are not P*»,* we must admit the validity of the proposition, contradicting to it, namely: «all *S* are P*»*. Connecting this premise with a premise «all *M* are *S*», admitted by us as valid, we will get ***Barbara*** syllogism with *S* as a middle term:

All *S* are P.
All *M* are *S*.
All *M* are P.

Thus, in conclusion we get that «all *M* are P*»,* and it contradicts the premise «some *M* are not *P»,* admitted as valid. «All *M* are P*»* can not be valid, if we have already assumed before that «some *M* are not P*»*.

Let's consider ***Bokardo*** reductum as an example*:*

O Some arts are not the imitation of nature.
A All arts represent wonderful.
O Some wonderful things are not the imitation of nature.

If we decide that the conclusion of this syllogism is invalid, the proposition, conflicting with it, must be valid, namely: «all wonderful things are the imitation of nature». We replace the major premise with this proposition and connect it with a minor premise, then we shall get the following ***Barbara*** syllogism*:*

All of wonderful is the imitation nature.
All of arts represent wonderful.
All of arts are the imitation of nature.

But this conclusion is in contradiction with the statement which we conceded. We received such a contradiction because we conceded the statement conflicting with our conclusion. If due to our last assumption we came to nonsense, then obviously that we can not make it and our primary conclusion is correct.

Thus, we have considered how different moods of figures 2, 3 and 4 are reduced to moods of figure 1. But why is such a deductum to the figure 1 necessary? The answer to this question will be the following. Since the applicability of syllogism axiom, dictum de omni, can be the most clearly seen from the figure 1, then obviously that the validity of the moods of other figures also becomes clear with the help of deductum to figure 1, because if with the help of syllogism axiom we receive evidence of figure 1 moods, then we also receive evidence of other figures, that are equal to moods of figure 1.

Questions for revision:

1. What is a reductum of syllogisms?
2. What do the letters **s, p, m, k** mean in denotation of syllogisms?
3. What is reductio ad absurdum?
4. Show the application of this method in **Bokardo** and **Baroko** deductum**.**
5. Why is deductum necessary?

LOGIC EXERCISES

Reduce the following syllogisms to the figure 1:

1. Not a single star is a planet.
All planets are round bodies.
Some round bodies are not stars.
2. Nerve current does not pass on the tied nerve.
Electricity passes on the tied nerve.
Electricity is not a nerve current.
3. No man is a bird.
All birds are animals.
Some animals are not people.
4. Not a single warm-blooded creature is a reptile.
All tortoises are reptiles. Consequently?
5. Burning is accompanied by emission of heat.
Burning is a chemical process. Consequently?
6. Some medications are poisons.
All medications are healing means. Consequently?
7. All tested hypotheses are theories.
Some hypotheses of natural sciences are not theories. Consequently?
8. All amoebae are rhizopods.
All rhizopods are simple animals. Consequently?
9. Some students waste time.
All those who waste time are carefree people. Consequently?
10. Not a single invertebrate is a reptile.
Some reptiles are snakes. Consequently?
11. All silver bromide compounds decompose because of the action of light.
This compound does not decompose because of the action of light.
Consequently?
12. All conifers save a foliage in winter.
Some conifers grow in the north. Consequently?
13. All the rivers of the Caucasus are fed by glaciers and snows.
All rivers, fed by glaciers and snows, are mountain rivers. Consequently?

Topic 15. CONDITIONAL, DISJUNCTIVE AND CONDITIONALLY DISJUNCTIVE SYLLOGIZMS

Conditional or hypothetical syllogisms. Until now we have considered syllogism in which categorical propositions serve as premises, but we saw that there exist also conditional and disjunctive propositions except for categorical propositions. Therefore, there can be such syllogisms, in premises of which conditional and disjunctive or both statements are included. As we saw, the chart of conditional statement would be the following:

If *A* is *B*, then *C* is *D*.

The first statement, as we saw, is called «reason», the second one is called «consequence». It is possible to create such a syllogism in which one of the premises will be conditional proposition; then we will get conditional syllogism.

There are two types of conditional syllogisms:

1. Modus ponens, or constructive mood.

If *A* is *B*, *then C* is *D*.
A is B.
Consequently, *C* is *D*.

Example:

If rains, the asphalt is wet.
It is raining.
Consequently, soil is wet.

This type of deduction is called modus ponens, because here the reason is asserted, it is stated (from ponere – to put); the minor premise here contains the statement of the reason. Since the reason is stated here, the consequence is also stated because in this case the reason is a cause of consequence.

The second type of conditional syllogisms is called:

2. Modus tollens, or destructive mood. It is called modus tollens because the minor premise here contains negation, notably the negation of consequence (tollere – to destroy).

If *A* is *B*, then *C* is *D*.
C is not *D*.
Consequently, *A* is not *B*.

Example:

If it rains, the asphalt is wet.

But the asphalt is not wet.

Consequently, it is not raining.

Here the consequence is negated in minor premise, as a result the reason is negated in consequence.

Therefore, we have two types of conditional syllogisms. The first one is also called a constructive mood, because we get an affirmative conclusion there: the second one is called destructive mood because there we get negative conclusion.

It should be noted that in conditional syllogisms one can deduce only from the statement of the reason to the statement of consequence and from negation of consequence to negation of reason, but one can not deduce from the statement of consequence to the statement of reason and from the negation of reason to the negation of consequence. It is so because one and the same operation can be created by different reasons. Actually, if I deny that stated reason provoked one or other operation, then it does not lead to the consequence that any other reason could not provoke it. If I state that such an operation took place, it does not mean that it is caused by this reason because there could be plenty of other reasons that could cause it.

We shall consider the following conditional syllogism to explain it.

If someone reads good books, then he acquired knowledge.

N acquired knowledge.

Here we state the consequence. Can we state the reason here? Does it follow here that N reads good books? No, it does not, because he could acquire this knowledge by several other means, for example, by communication with scientists, listening to lectures, etc. Reading of good books is not the only reason of acquiring knowledge, there exist many other ones.

Let's try to negate the reason, let's consider the same syllogism.

If someone reads good books, he acquires knowledge.

***N* does not read good books.**

It does not follow from this that he will not acquire any knowledge.

Disjunctive syllogisms are called so because here one of the premises (notably the major one) contains a disjunctive proposition. As we have seen, the generalized form of the disjunctive proposition would be:

A is either ***B*** or ***C***, or ***D***, or ***E***.

Every term of the disjunctive statement is called the alternative.

There are two types of disjunctive syllogism.

1. Modus ponendo tollens. One of the terms of the major premise disjunction (or one alternative) is stated in the minor premise here. Therefore, in the conclusion all the rest terms are negated.

The form of this syllogism is the following:

A is either *B*, or *C*, or *D*, or *E*.
A is B.
Consequently, A is neither C, not D, not E.

For example:

Triangles can be either acute-angled, or obtuse-angled, or right-angled.
This triangle is acute-angled.
Consequently, it is neither rectangular nor obtuse-angled triangle.

For the validity of this type of deduction, the validity of the major premise is necessary here, that is: it is necessary that all the terms of disjunction should be enumerated and they should not eliminate one another.

2. Modus tollendo ponens. As opposed to the previous type, all the terms of disjunction in this type are negated, except for the one, which is stated in the conclusion.

Its chart is the following:

A is either *B*, or *C*, or *D*.
A is not either B. or C.
Consequently, *A* is *D*.

For example:

Triangles can be either acute-angled, or obtuse-angled, or rectangular.
This triangle is neither acute-angled, nor obtuse-angled.
Consequently, it is rectangular.

This type of disjunctive deductions is used in geometry under the name of indirect evidence.

For example:

The known sum must be either larger, or less, or equal to smth.
But it is neither larger, nor less.
Consequently, it is equal.

The condition of validity of the disjunctive syllogism, as it is easily seen, is reduced to the validity of the disjunctive propositions that exist in disjunctive syllogism as premises.

Conditionally disjunctive syllogisms. Finally, the last group of deductions is the conditionally disjunctive syllogisms, or lemmatic syllogisms. The major premise in these deductions consists of two or more conditional propositions, and the minor one consists of the disjunctive proposition.

Here we distinguish the following four forms of deductions:

1. Simple mood ponens, or structural mood. It is called **ponens** because a minor premise is affirmative; it is called structural because the conclusion is affirmative.

Its chart is the following:

If *A* is *B*, then *C is D;* if *E* is *F*, then *C is D.*
But or *A* is *B*, or *E* is *F.*
Consequently, *C* is *D.*

For example:

If science reports useful facts, then it deserves attention. If the study of science serves as an exercise for mental abilities, then it also deserves attention.
But every science either reports useful facts, or the studying of it exercises mental abilities.
Consequently, every science deserves attention.

Let's note that reasons are stated in the minor premise here in this form of deductions.

The complex mood differs from the simple one in that, that there are no one generalized reason or generalized consequence in conditional propositions, as we see in simple mood, and the very consequence is expressed by disjunctive proposition.

2. Complex mood ponens, or structural mood. Its chart is the following:

If *A* is *B*, then *C* is *D;* and if *E* is *F*, then *G* is *H*.
But either *A* is *B*, or *E* is *F*.
Consequently, either *C* is *D*, or G is *H*.

For example:

If I jump out of the window, I will get injuries.
If I go down the stairs, I will burn.
But I have to either jump out of the window, or go down the stairs.
Consequently, I will either hurt myself, or burn.

The reason is also stated in minor premise in such a type of deduction.

3. Simple mood tollens, or destructive mood:

If *A is B*, then C is *D;* and if *A is B*, *then E* is F.
But *C* is not *D* and *E* is not *F*.
Consequently, *A* is not *B*.

For example:

Those, who want to begin war, have to either borrow,
or increase taxes.
They can do neither.
Consequently, they can not begin war.

The consequences are negated in the minor premise in this type of syllogism, and therefore, the reasons are also negated.

4. Complex mood tollens, or destructive mood:

If *A* is B, then S is *D*; if *E* is *F*, then *G* is *H*.
But C is not *D* and *G* is not *H*.
Consequently, *A* is not *B* and *E* is not *F*.

For example, a person, who wants to have a car, can reason the following way:

If I were rich, then I would buy a car.
If I were dishonest, I would steal it.
But I will not buy and will not steal.
Consequently, I am not rich and not dishonest.

Lemmatic deductions by the number of consequences are divided into dilemmas, trilemmas, etc.

Validity of lemmatic deduction depends on the validity of conditional propositions in major premise and completeness of disjuncted terms of minor premise. Since these conditions are not always met, the lemmatic deduction becomes a source of mistakes.

During the middle ages the alternatives of lemmatic deduction were called «horns» of syllogism; and syllogism itself was called sillogismus cornutus. This name comes from the use of dilemma in arguments. Obviously, the peculiarity of dillematic deduction consists in the following: whatever alternative we choose, we come to the same unpleasant conclusion. The opponent can choose any alternative he wants, but he will be caught anyway, he will «get into the horns of dilemma».

Incomplete enumeration of disjunction terms most often becomes a source of mistakes. It is sometimes impossible to run out of all possible number of cases with two alternatives. Dillematic deduction is often created so that only two alternatives are taken from all possible alternatives, therefore we get a mistake.

For example:

> **If some student** likes to study, he does not need any encouragement. If he feels disgust for studying, then any encouragement will be useless.
> **However, a student** might either like studying, or feel disgust toward it.
> **Consequently,** encouragement is either needless or useless concerning studying.

This dilemma is invalid because the "love for studying" and «disgust toward studying» are no the only possible alternatives because there are such students that do not like studying, but also are not disgusted by it; encouragement can be effective for such students.

Questions for revision:

1. What syllogisms are called conditional?
2. What syllogisms are called disjunctive?
3. What types of syllogisms do we distinguish?
4. What does the validity of disjunctive syllogisms depend on?

5. What is an alternative?
6. What syllogisms are called conditionally disjunctive?
7. What four types of conditionally disjunctive syllogisms do we distinguish and how do they differ from each other?
8. What is dilemma, trilemma?
9. What does validity of lemmatic depend on?

LOGIC EXERCISES

Show what type of deductions do the following deductions belong to. Draw a conclusion, where conclusion is lacking. If there is a mistake in deduction, show where and why it appeared.

1. If water is boiling, it is evaporating.
Water is boiling.
Consequently?
2. If the field is well cultivated, then the crops will not suffer from drought.
This field is well-cultivated.
Consequently?
3. If the earth has the exact shape of a sphere, then the meridian degrees on different latitudes should be equal.
But meridian degrees are different on different latitudes.
Consequently?
4. If this verse is hexameter, then it must have 6 feet.
This verse is not hexameter, therefore it does not have 6 feet.
Consequently?
5. If a criminal is not guilty, he will be discharged.
A criminal was not discharged.
Consequently, he is guilty.
6. If a lesson is difficult, students master it badly.
The students mastered this lesson badly.
Consequently, this lesson is difficult.
7. If the bay freezes, the ships can not be go into it.
Ships can not go into it.
Consequently, the bay froze.
8. If a danger threatens the train, a railway watchman goes out with a red flag.
A railway watchman did not go out with a red flag. Consequently?

9. If the frosts are strong, the crops die.
The crops died.
Consequently, the frosts were strong.
10. If a temperature goes down below freezing-point, not a single seed will sprout.
Not a single seed sprouted. Consequently?
11. If False Dmitriy I had been a pupil of Jesuits, he would have known Latin well.
False Dmitriy I knew Latin badly. Consequently?
12. This medicine is either useful, or harmful, or neutral.
It is useful. Consequently?
13. This action is either praiseworthy, or shameful, or moral, or indifferent.
It is neither praiseworthy, nor shameful. Consequently?
14. A way of comet is either an ellipse, or parabola, or hyperbola.
A way of this comet can be neither a parabola, nor hyperbola.
Consequently?
15. This action is either permitted, or forbidden.
It is not permitted. Consequently, it is forbidden.
16. Every political reform is either reasonable, or useless.
NN reform was useless.
Consequently, this reform was not unreasonable.
17. Lines are either straight, or curved, or broken.
This line is not crooked and not broken. Consequently?
18. Vertebrates are either mammals, or birds, or reptiles, or fishes.
This vertebrate is neither mammal, nor bird, nor reptile.
Consequently?
19. Poetic works can be either epic, or lyric, or dramatic.
The satire «Rumours of Strangers» by Dmitriev is a lyric work.
Consequently?
20. Bacteria can be either spherical, or spiral, or rodlike.
A bacterium of relapsing fever are spiral. Consequently?
21. Every region of Russia is either tundra, or forest, or steppe, or the region of evergreen trees.
This outskirts of Russia are not tundra. Consequently?
22. If some science delivers useful facts or its study exercises power of apprehension, then it deserves to be studied.
Geometry either delivers useful facts, or its study develops power of apprehension.
Geometry deserves to be studied.

23. If criminals are mentally ill, they must be isolated from society.
If criminals are people mentally healthy, they must be punished.
But criminals are either mentally ill, or mentally healthy.
Consequently, criminals must be either isolated from society, or punished.
24. We like beautiful flowers either because of their aroma, or because of their looks.
We like roses because of their smell.
Consequently, we do not like roses for their looks.
25. If he leaves for the city, he must pay for the railroad ticket and for the hotel.
However, he can pay neither for one, nor for another.
Therefore, he can not leave for the city.
26. If he were clever, he would see the mistake; and if he were sincere, he would admit it.
However, he either does not see his mistake, or does not admit it.
Therefore, he is either not clever or not sincere.
27. If this peasant had a scythe, he would mow his rye.
If he had a sickle, he would reap it.
But he did not mow and did not reap rye.
Consequently?
28. If the income of organism exceeded his expenditure, an organism looses weight.
If income exceeds expenditure, it gains weight.
However, the organism does not loose weight and does not gain weight.
Consequently?
29. If Caesar were superstitious, he would have yielded to Kalpurnija's requests not to go to the senate.
If Caesar were careful, he would dismiss Brut.
Caesar did not yield to Kalpurnija's requests did not dismiss Brut.
Consequently?
30. If heterogeneous elements more or less retain their properties while combining, then they create a mechanical mixture. If heterogeneous elements turn into new substance while combining, they form a chemical compound.
Heterogeneous elements either retain their properties, or turn into new substances while combining.
Consequently?

Topic 16. SHORTENED AND COMPOUND SYLLOGISMS

Shortened syllogisms. Let us consider those syllogisms, that are called shortened and compound syllogisms. They differ from other ones in form. Some people say sometimes that we never use the syllogism in thinking. But it is not so, because in everyday life we use the syllogism quite often, and it is not always expressed fully, and that is exactly because some of its parts are omitted. These syllogisms are called shortened syllogisms, or enthymemes.

Enthymeme is a syllogism, a part of which we carry, and express another part. We can put every part of a syllogism out and still think syllogistically. For example, if we use the following expression towards any one "a person must be foolish to do such things", then this phrase is a syllogism, and if we make a full form of the syllogism, it will look as following:

All the people who do such things are foolish.
This person does such things.
Therefore this person is foolish.

To explain how this omission of the parts of the syllogism, let us take a complete syllogism, for example:

A vice merits censure.
Stinginess is a vice.
Therefore, stinginess merits censure.

This example can be used to show the next three kinds of enthymeme.

Kind 1:

Stinginess merits censure, because it is a vice. (Here a major premise is omitted.)

Kind 2:

Stinginess merits censure, because a vice merits censure. (Here a minor premise is omitted.)

Kind 3:

A vice merits censure, and stinginess is a vice. (Here the conclusion is omitted and exactly because it is obvious.)

Epikheyrema. It is a syllogism, in which both of the premises contain enthymemes. The scheme of the erpikheyreme is:

_M_ is _P_, for it is _N_.
_S_ is _M_, for it is _O_.
Therefore _S_ is _P_.

First premise should look like:

All _N_ are _P_.
All _M_ are _N_.
Therefore _M_ is _P_.

The second premise should look like:

All _O_ are _M_.
All _S_ are _O_.
Therefore all _S_ are _M_.

For example:

Lie merits disdain, for it is immoral.
Flattery is lie, for it is intentional perversion of the truth.
Therefore flattery must be disdained.

It is well seen in this syllogism every of the premises is a judgment, which is a conclusion with the middle term. If the middle term is given it is quite enough to restore the whole syllogism.

Compound syllogisms

Polisyllogisms. It happens quite often in scientific works when we join several syllogisms into one, and we get a chain of syllogisms, i.e. polisyllogism.

The joining of the syllogisms happens in a way that a conclusion of one syllogism is a premise for another. The syllogism that precedes is called prosyllogism, the syllogism that follows is called episyllogism.

The scheme for a polisyllogism is as the following:

All B are A.
All C are _B_. > **Prosyllogism.**

Therefore all C are A.

All _C_ are _A_.
All _D_ are _C_. > **Episyllogism.**

Therefore all *D* are *A*.

There are two types of polisyllogisms. According to the first one a conclusion goes from more general to less general, according to the second one a conclusion goes vice versa from less general to more general. The first type is called progressive, the second is called regressive.

An example of a **progressive** polisyllogism:

All **vertebrates** have red blood.
All mammal are vertebrates.
All mammal have red blood.

All **mammal** have red blood.
All carnivores are mammal.
All carnivores have red blood.

All **carnivores** have red blood.
Tigers are carnivores.
Tigers have red blood.

Here the conclusion goes from more general to less general (vertebrate, mammal, carnivore, tiger), i.e. forward towards to the content, for the content in quotient notions is bigger.

An example of a regressive polisyllogism:

Vertebrate are animals.
Tigers are vertebrate.
Tigers are animals.

Animals are organisms.
Tigers are animals.
Tigers are organisms.

Organisms decay.
Tigers are organisms.
Tigers decay.

Here the conclusion goes from less general to more general (vertebrate, animal, organism, decayable).

Sorits. Sometimes joining several syllogisms we can omit some premises to make our thoughts smoother. Then it appears the one that is called sorit (from Greek soros – heap). There are two kinds of sorits: 1) Aristotelian sorit, when the less premise of every single syllogisms is omitted, and 2) Gokleniev sorit, when the bigger premise of single syllogisms is omitted. For examples:

a) Aristotelian sorit

Bucephalus is a horse.
A horse is quadruped.
Quadruped is an animal.
An animal is substance.
Bcephalus is substance.

If this sorit has a full form, i.e. if we restore the omitted premises, then we would get the following three syllogisms:

1) A horse is a quadruped.
Bucephalus is a hourse.
Bucephal is a quadruped.

2) A quadruped is an anima.
[Bucephalus is a quadruped.]
Bucephalus is an animal.

3) An animal is substance.
[Bucephalus is an animal].
Bucephalus is substance.

b) Gokleniev sorit

An animal is substance**.**
A quadruped is an animal.
A horse is a quadruped.
Bucephal is a horse.
Bucephal is substance.

This is a Gokleniev sorit, for the big premises are omitted. If we restore the omitted premises we would get the following:

1) An animal is substance.
A quadruped is an animal.
A quadruped is substance.

2) [A quadruped is substance.]
A horse is a quadroped.
A horse is substance.

3) [A horse is substance].
Bucephalus is a horse.
Bucephal is substance.

Questions for revision:

1. What is enthymeme?
2. What is polisyllogism?
3. What is prosyllogism and episyllogism?
4. What is a sorit, and what kinds of them do you know?

LOGIC EXERCISES

Add the missing parts of the following syllogisms:

1. Every person wishes virtue, because every person wishes happiness.
2. A slave is a human, that's why one shouldn't be captive.
3. Nevertheless many contested regulations merit the attention, because many of such regulations can be true.
4. Some pleasures do not merit approval. That's why some of the pleasures are not honourable.
5. This supposition is too good to be carried out.
6. He shows bad taste in elegant, for he does not like painting.

Define the form of the following compound syllogisms:

Everything material is in the space. Everything that is in the space is extensive. Therefore everything material is extensive. Nothing extensive is simple. Therefore noting material is simple.

Express in the syllogistic form:

a) You are Tsar: live alone.
b) The dead man Klit will not be in paradise,
   The terrible sins he did.
c) I did give birth to you, I will do kill you.
d) He is not Andriy to yield to captivity alive.
e) He is too old to go to war to be sure.
f) Youth is glad to have the future.
g) The praises are attractive, how not to desire them.
h) You are coward, and not my son.

Topic 17. ABOUT INDUCTION

In this topic we will consider that kind of reasoning which is called induction. The distinction between these two kinds of conclusion is brought to following.

In deductive reasoning by recognition of any universal proposition we must recognize any particular proposition or less universal one; in inductive reasoning we proceed from the recognition of some particular proposition to the recognition of universal proposition.

Definition of induction. The induction is thinking process by means of which we deduce, that truth in any particular case or particular cases will be true in all cases, similar with previous. For example, I have noticed, that in several cases, the plants grew from moisture inflow better; From these supervision I come to the conclusion, that it will be fair towards all cases of growth of known class of plants. If I observe, that any heavy solids by submergence in the water lose the part of the weight, equal to weight of superseded liquid by them and I come to the conclusion, that it will be fair concerning all solids and concerning all liquids.

Thus, in the process of inductive conclusion we conclude from the cases which we observed and investigated, to cases which we did not observe and did not investigate. Further, as the result, in the process of induction from supervision of the part of the class we conclude to all class. The induction is the conclusion from particular to general, or conclusion from less general to more general.

Not everybody, however, consider it to be induction; some philosophers think that it is necessary to term induction a conclusion from particular to general in which the conclusion concerns all investigated cases. It is that induction which full or complete called

Full and incomplete induction. Full induction is that kind of induction in conclusion of which it is spoken only about those cases about which it is spoken as well in sumptions. If I, having considered months of the year, find, that none of them has more than 31 days, and I express it in the form of general position, it will be a full induction. If I, having investigated a nationality of every pupil sitting in a class, and having learnt, that each of them is a Frenchman, I express in the form of general

position: «All pupils in the class are gist Frenchmen» it will be a full induction. According to some people, it is the only induction, deserving the name of the induction because it has certainly authentic character. But if to accept that definition of induction which was offered above for us will become clear, that such conclusions cannot be referred to the induction because the induction in the true sense is conclusion from known to the unknown. In the inductive conclusion something should always turn out as new, while in the full induction nothing new is impossible, because the conclusion in the full induction is only brief repetition of what in sumptions contains: it is the simple conclusion of sumptions. Inductive conclusion is the incomplete induction, which we from the research of only some cases conclude to the class of cases; having investigated only a part the class, conclude to all class.

Popular induction. There are inductive constructions which cannot meet requirements of scientific accuracy. These are constructions which the popular consciousness is inclined to use and which therefore are called popular induction.

If we have cases to observe multiple repetition of the similar phenomena, we start to think, that these phenomena will always take place, if only we had no chance to observe the phenomena contradicting them. If we, for example, had a case to observe many times in many places, that swans have white colour of feathers we come to the conclusion, that swans always and everywhere have white colour of feathers. Such conclusion Bacon named an induction through simple transfer in which there is no contradicting case because in it the conclusion on the basis of simple enumeration, in which we do not meet contradictory case because in it the conclusion on the basis of simple enumeration is made. It seems that the more cases of observable communication, the larger reliability we get from the deducible conclusion. Such induction cannot be recognized as authentic because that circumstance, that we did not meet the cases, contradicting that which we observed, is not the guarantee at all that always will be how we observed.

The popular induction differs from scientific induction. In this process we investigate every separate observable case, analyze it, reject all casual for the given phenomenon, search for its essential signs and make the conclusions, bringing in the conclusion the agreement of these last generalizations. Such conclusions only can have the more or less authentic character. It is possible to explain it by means of just resulted

example. If we on the basis of the observable swans by us make the conclusion, that "all swans are white", such induction will be popular because on the basis of careful researches concerning the colour of birds' feathers we should conclude, that colour represents something changeable, not connected with the swan nature that's why can easily happen that there will be the swans possessing black colour of feathers.

The induction should deal with necessary connection of things, but not with casual. The connection between white colour of feathers and swan's organization is not necessary; black colour of swan's feathers is not something that contradicts other generalizations. The colour of feathers for birds is not something essential, i.e. is not something on what the life or a being of birds could depend. Absolutely other business is, if we, having made supervision over the process of breath's swans, have told, that «swans breathe oxygen». It would be a correct scientific induction because the ability of inhalation of oxygen is a property without which birds are not conceivable. In the same way we act in all those cases when we in general should build inductive positions concerning the phenomena observed by us.

Concepts of nature laws**.** Using inductive conclusion, we can open laws of nature, which are essence of the suggestion which express constant quality or connection of any phenomena. For example, statement, that «a liquid in communicable vessels is at the same level», is a nature law. «Animals inhale oxygen» is he nature law.

It is necessary to recognize the first essential line of the law of the nature its generality: the description of any isolated fact, at least it was quite right, cannot be named by the law. The law always serves for expression of properties, of general to number of the phenomena or a class of the phenomena.

Necessity is the other essential feature in the concept of the law. The statement «a body deprived of support, will fall» is a law because the body deprived of support will be necessary to fall. «Iron is heat-conducting » is the nature law because warmth will be extend i.e. if the warmth will be brought in the contact with iron, this last will necessary conduct it. If it has appeared, that studied connection is available once, and another time there is no, we that suggestion which serves for expression of this connection, could not name the law. That is why the scientific generalizations which are considered to be laws, cease to be them at once as soon as one case found when they are not applied.

The basis of induction. We investigate by means of induction the nature making up general statements. But on what we are based, when we make up such general statements? What gives the right to us to generalize or on what we lean, when we conclude on one fact or on the number of similar facts about a class of the facts similar to them? What gives the right to us to make the conclusions from observable cases to not unobserved? For example, having investigated compressibility of one or two gases, we, generalizing, assert, that «all gases are compressed». To have the right to make the conclusion of what we observed, to what we did not observe, we should start with the assumption, that things possess constant properties, i.e. things are arranged so, that today the known reasons cause the same actions, as yesterday, tomorrow the known reasons will cause the same actions, as today. If the contact of iron with oxygen makes today rust in it we have the confidence, that so will be always because iron and oxygen possess such properties, that their interaction will always make rust. Thus, we have belief that things, being put in the certain conditions, possess constant qualities and consequently in all cases operate uniformly. It is possible to express it differently if to say, that in the nature there is a certain order. Only thanks to that we have such belief, we can conclude from observed things to unobserved.

Questions for revision:

1. How is the induction defined?
2. What is full and incomplete induction?
3. What is the popular induction and how does it differ from scientific?
4. On what is the conclusion in popular induction based?
5. What are nature laws, and what are their prominent features?

Topic 18. METHODS OF INDUCTIVE RESEARCH

Definition of causality. In the previous chapter we saw, that with the help of inductive conclusion we can discover nature laws; with the help of inductive conclusion we can learn causal relationship of things too. But what is the reason? It is necessary to understand the phenomenon which is connected with other phenomenon called an action that its occurrence inevitably entails occurrence of the action and destruction of its inevitably entails the action of destruction. An external sign of the reason is represented to us by the preceding phenomenon, and a sign of action that is represented by the subsequent. The causal relation, or causal relationship, we should recognize there where the known phenomenon inevitably, invariably follows another. For example, the occurrence of fire invariably causes the occurrence of warmth.

For cognition of causation we should distinguish, which of replacing each other phenomena are preceding and which of them are subsequent. After that our immediate task is a research of how these preceding and subsequent are connected between each other; whether that sign which has been specified above because only certain connection of preceding and subsequent can be recognized by us as causal relationship of the phenomena. Exactly, originally we should separate intellectually preceding from subsequent, and then, if it is possible to make their real division. Only on the assumption of that, we are able to see, what changes of preceding entail changes of subsequent and what of changing phenomena we should admit as a reason and what as an action.

Experience and supervision. For separation preceding from subsequent sometimes it is necessary for us to change circumstances by which the studied phenomenon is performed: we must interfere with a course of the phenomena and alter this last one. Such intervention in a course of the phenomena is called experience or experiment. If we, studying a quality of any phenomenon, do not interfere with its current and such method of cognition will be called supervision.

Distinction between supervision and experiment is brought to following. In the process of supervision we study the phenomena in that way in what they are given to us in the nature. With the help of supervision we study qualities of such illness as cholera because we cannot make it artificially. In experiment we change those circumstances by which the studied phenomena are accomplished by us. In experiment, we change as we wish the combinations of things and circumstances and then we observe the result. So, the chemist, using electric current, separates two components of water - oxygen and hydrogen. Thanks to experience we can make that modification of the phenomena which we require for definition of their causal relationship.

It is easy to see those advantages which are represented by the experiment in comparison with the simple supervision. First of all, experiment promotes multiplication of the number of studied phenomena. If we study any phenomenon only with the help of supervision, we should wait when there will be a phenomenon interesting for us in the nature, for example, snow, the electric phenomena, etc. By means of experiment we can, having reproduced the known phenomenon artificially, to repeat it and, thanks to it, pay attention to those sides of the phenomenon which escape by simple supervision.

It is possible to isolate the studied phenomenon by means of experiment, to separate it from everything, that for our purpose is unimportant, and thanks to it we can receive an exact case of that phenomenon which we study.

Besides, by means of experiment we can also allocate preceding from subsequent, and thanks to it we can define causal relationship between them, exactly by means of experiment we can allocate those circumstances which are insignificant for appearance of the studied phenomenon.

For definition of causal relationship there are four ways, or methods of research, which D.S Mill called as: 1) method of agreement, 2) method of difference, 3) method of rests and 4) method of attendant changes. Thanks to these methods we can define, how preceding and subsequent are connected with each other.

Method of agreement. Let's deduce the rule of this method on the example. Let us assume that, I see in the kitchen, that if in an oven to put some coil and they inflame, water which is in a copper, starts to boil and steam is formed. Let us assume that, after that I go to the field and see that the water in a copper under which the fire have been dissolved, boils too and steam is formed too. At last, I go to the laboratory of the chemist and see, that water in the vessel under which there is alcoholic torch, boils and steam is formed too. I put a question: what is the reason of steam production? To answer this question, I intellectually separate preceding event from subsequent one and among the first I look for the reason of the given phenomenon. I could think, that the reason of steam generation is the presence of coal in the oven, but this is contradicted by that circumstance, that in the second and in the third from observed by me steam generation cases were not coal. Therefore coal can not cause steam generation if it could happen without it. In that case, probably, the reason of steam generation is the presence of firewood; but also this supposition is incorrect, because firewood was not in the first and third cases. It is impossible also to tell, that the reason of steam generation is alcohol because it was not in the first and second cases. To answer the question interesting for us, we should look among previous for such element which would be the general for all cases; it also will be the real required reason of steam generation. Such common thing is fire which is in number of all observed cases by me and which we should consider as the reason of steam formation. It is causality definition on the method of agreement.

Thus, when we define causation by means of the method named the method of agreement, or similarity, we compare among them various cases in which the studied phenomenon takes place, singling out in them preceding and subsequent parts.

Let's designate preceding by the letters *ABCDE,* and the subsequent by the letters ***abcde***, and let ***a*** will be that action of the reason we need to define. Let's presume, that we investigated *A* in connection with *B* and *C,* and their action was ***a, b, c;*** let's presume further, that we investigated *A* in connection with *D* and *E*, but without *B* and *C,* and their action was ***a d e***. Then neither *B,* nor *C,*

neither *D*, nor *E* can not be the reasons ***a*** whereas in the first case ***a*** appears without *D* and *E*, and in the second case without *B* and *C*. That's why the reason of ***a*** can be only *A*.

The way of causality's definition by the first method can be formulated as following: «if for two or more number of cases of the investigated natural phenomenon is common only one condition that only this condition in which all the cases are conformed, is the reason of the given phenomenon».

This method can be symbolized by means of the following scheme:

	Case 1	Case 2
The preceding....	***A B C***	***A D E***
The subsequent....	***a b c***	***a d e***

Method of difference. By the second method of causal relationship's research of the phenomena is made in such a way. Let's presume that a number of preceding *A B C* and a number of the subsequent *a b c* is given to us. It is required to define, what is the reason of *a*. For this purpose among the preceding we will reject one member, for example *And* then among the subsequent the member disappears *and*. If the removal of *A* entails removal of *a* it is a sign on that *And* there is a reason *and*. Thus, by this method we compare the case in which the investigated phenomenon is present with the case in which the investigated phenomenon is not present. This method is called method of difference, and its rule is formulated in such a way:

«If a case in which the known natural phenomenon comes, and a case in which it does not come, have all common conditions, except only one, and this one condition meets only in the first case, that condition in which both cases are separated between each other, and there is the reason or a necessary part of the reason of a studied natural phenomenon».

For example, we know, that light bodies: feathers, down, cotton wool don't fall with that speed with what other bodies fall. We can put the question: what is the *reason* of unequal speed of falling? To answer this question, we, among conditions under which falling of bodies is performed, eliminate air, we make falling

of bodies in the glass vessel from which air has previously been pumped out. Then we see, as the mentioned bodies fall with the same speed with which other bodies also fall. If air removal has caused removal of inequality of speed falling that means, that air, but to say more exactly resistance of the air, that is the reason of the inequality of speed falling.

This method can be symbolized by means of the following scheme:

	Case 1	Case 2
The preceding....	***A B C D***	***B C D***
The subsequent....	***a b c***	***d b c d***

The connection of the method of similarity with the method of difference is called the connected method. It is possible to explain it by means of the following example. I have noticed, that any plant is constantly in abundance with any soil, but at the same time I find, that it does not grow on any other soil. From this I make the conclusion, that the reason of growth of the given plant is the soil (i.e. any chemical components of this soil).

Method of rests. The essence of this method is brought to the following. We were given a number of phenomena *ABC* which we consider to be preceding, and then a number of the phenomena *a b c* which we consider to be subsequent. Let us know from the previous experience, that *A* is a reason of *a*, and *B* is a reason of b; then, having subtracted these known reasons for us, we will receive, that C is a reason of *c*. With the help of this method a new planet Neptune has been discovered. It turned out, that observable movements of Uranium were not at one with the movements found with the help of calculation. Movement of Uranium now slowed down, now accelerated. It was necessary to define a cause of movement disturbance of Uranium. It was known, what quantity of disturbance in Uranium movement has been obliged to influence of known heavenly bodies at that time. When the subtraction of this known already influence was made, there was the disturbance, the reason of which we needed to find. It was necessary to presume the

existence of one more unknown planet which is taking part in the definition of the way of Uranium. This planet turned to be Neptune.

The rule of the method of rests is the following:
«Subtract from the given natural phenomenon that part, which thanks to former inductions, is known as an action of certain preceding, and the remaining part (rest) of the natural phenomenon will be an action of the other preceding one».

Method of attendant changes. But sometimes none of the methods brought above, turns out to be unsuitable for research of causation of the phenomena. It happens, when the known phenomenon cannot be separated or isolated from the other phenomenon by its nature. For example, «the warmth condition» and «volume of solid» can not be separated from each other because it is impossible to extract warmth from a body in such a way as to exist separately from bodies. So, if we need to study a causal relationship between warmth and volume of solid at first sight it solids. Thus, if we need to study the causation between warmth and volume of solid that at first sight it seems impossible to study this connection. But actually, if we can not isolate or exclude such phenomenon we can make any change in it and then to see, whether this change causes any change in that phenomenon which is connected with it. For example, it is possible to increase or reduce and at the same time to see what happens with the volume. If with the increase of warmth the volume of solid increases and with the reduction of the warmth its volume decreases, we conclude, that warmth is the reason of it.

«If a change of preceding *A* is always accompanied by the change in the subsequent *a*, and others subsequent *b* and *c* remain the same, or, on the contrary, if each modification in *A* was preceded by the change *a* which has not been noticed in other preceding and that's why we can conclude, that *a* fully or partly is the action *A* or, at least, is connected causation with action».

As an illustration of using this method we will consider, how the Moon influences on the surface. We can not perform the experience in the absence of the Moon, i.e., we can not eliminate the Moon, we can not observe, which phenomena are destroyed on

the Earth together with the destruction of the Moon, or what phenomena appear when the Moon occurs. But we can observe what phenomena on the Earth appear when the Moon changes the position concerning the Earth. We find that all changes in the position of the Moon are accompanied by certain changes in the water height in ocean, and a part of the Earth or the closest to the Moon or more distant from it. From this we know, that the Moon is fully or partly the reason of tides

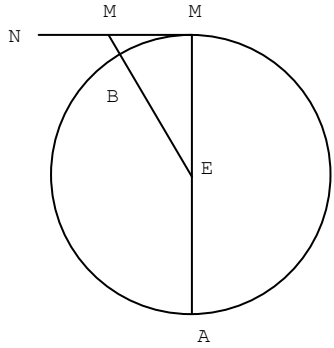
The method of attendant changes is used in the definition of causality in the phenomena of the public life. When we, for example, find, that the quantity of crimes decreases together with the distribution of national education, we assume that these phenomena are in causation with each other.

Questions for revision:

1. How is the reason defined?
2. What is an experiment?
3. What is the distinction between experiment and supervision?
4. What are the advantages of experiment before supervision?
5. What four methods of causation exist?
6. How is the method of agreement formulated? Its rule and scheme.
7. How is the method of difference formulated? Its rule and scheme.
8. How is the method of rests formulated? Its rule.
9. How the method of accompanying changes is formulated?
10. When the method of accompanying changes is applied?

Topic 19. ESSENCE AND THE ROLE OF DEDUCTION

For the opening of laws of the nature it is necessary to use inductive methods of research as we saw it in the previous theme. But the opening of laws promotes not only an induction, but similarly the deduction.



The deductive method of research can be used in sciences in two cases. First, it is used as means of an explanation of the law, which is already opened inductively, when the found law can be reduced to one or several laws of a more general character which therefore can be named the supreme laws. Secondly, the deductive method is used as means of opening of laws which cannot be opened inductively, but which can be probably deduced deductively from the already known laws.

Deductive explanation of laws

But what does the term explanation mean in this case, what does it mean to explain the law? In this case the concept of an explanation is used in the same sense in which it is used when it goes about an explanation of the fact. We consider the known fact to be explained in that case when it can be deduced from any general law. For example, the person has died because of injection of any substance into a stomach. We ask, what was the reason of the death and how can it be explained? The given fact will be explained, if, ascertaining, that the substance injected into a

stomach, has all features of arsenic, we can deduce this fact from the general state « arsenic is the poison ». The process of deduction applied by us in this case, is quite obvious.

Just as the facts can be explained deductively so the laws can be explained. We mark the following distinction between laws. As the law, which is inductively found, cannot be deduced by means of deduction from any other more general or supreme law, it is called the empirical law. (It is as we saw an induction through simple transfer.) For example, from numerous supervisions over the influence of quinine on an organism has been drawn an inductive conclusion, that « quinine cures a fever »; it is the inductive law, but at the same time it is the empirical law because it is not explained why quinine cures a fever. If we shall answer on last question we shall explain the empirical law; then the empirical law will stop being empirical and will become derivative. The explanation of the empirical law consists in its reduction to more general law. There are three kinds of such explanations of empirical laws in sciences about the nature.

The first kind. We sometimes discover laws of any phenomenon by means of an induction and then we come to belief, that this law is deduced from other laws. So, Kepler has opened the law, that « planets move on an ellipse », but he could not explain why it is so. Newton has shown, that this law can be explained by two more common laws, the law of the centrifugal force, aspiring to move a planet on a tangent to its orbit, and the law of gravitation which aspires to throw a planet to the Sun. It is easy to see, that both these laws have more general character, **than** the law of movement of planets.

The second kind. We often open a causal relationship between the phenomena ***A*** and ***D;*** it seems to us, that ***A*** and ***D*** are connected with each other directly. Meanwhile subsequently we are convinced that between specified two members is an intermediate member or a few of them. For example, between ***A*** and **C** which we considered as the reason and action, there is an intermediate member ***B*** so the relation between ***A*** *and* ***C*** appears to be not the

only law of causality, and a circuit of such laws in which ***A*** is the reason of ***B*** and only ***B*** is the reason of ***C***. E.g., the touch of sugar with tongue causes sensation of sweet taste. Therefore it is possible to say that sugar is the reason of sensation of sweet taste. But between a touch of sugar with tongue and occurrence of sweet taste there is a lot of parts. Sugar is absorbed by a mucous membrane of language, and comes to contact with fibers of flavoring nerves. From this there is a chemical process in a nerve which, extending on a nerve in the form of molecular movement, reaches a brain. Result of excitation of a brain is called that condition which is known as sensation of sweet taste. Thus, between a touch of sugar with tongue and sensation of sweet taste there is a lot of processes.

General provisions which serve for expression of these intermediate processes serve for an explanation of the law of a causal relationship between ***A*** and **C**. It might seem, that this second kind of an explanation does not comprise any deduction, any leading to another more the general law. Actually such leading exists, because laws of intermediate processes appear to be more general than initial position. Really, if we speak, that sugar is absorbed by a mucous membrane of tongue it is because here we assume the general provisions, that mucous membranes in general possess ability to absorb various substances. Further, if we speak, that in a flavoring nerve occurs a chemical process which extends on a nerve in the form of molecular movement we consider this process as a special case of molecular movement in case of occurrence of chemical process. At last, when we speak, that excitation of a brain causes sensation of sweet taste than it is a special case of more general process when excitation of a brain causes those or other mental processes.

Thus, the explanation here consists in that, that between two given members of a causal relationship the intermediate processes are inserted and they can be explained by more general laws.

The third kind. At last, the third kind of an explanation of laws consists in connection of several laws in one law that unites them. This kind of an explanation represents simple process of generalization. For example, we name the known process as

burning. But if between burning and a covering of iron with rust we see something the common: that burning and a covering with rust are the processes of connection with oxygen than we bring them to the supreme concept which unites them - "oxidation". This more general concept serves as an explanation for less general concepts.

Value of an explanation of laws. Thus, having examined three kinds of explanation of laws, we see, that the explanation of any law consists in its reducing to more general laws. This explanation of laws, or transformation of empirical laws into derivatives, has enormous scientific value. The science makes each time a step forward when the empirical law is made to derivatives by means of deduction because the explanation of the empirical law precisely determines the sphere of its appendix.

To show the importance of transformation of empirical laws into derivatives we shall give an example. So, it has been discovered empirically that water in the pump cannot rise above 33 foots. It was the fact, but the fact was not explained. Thereof it was impossible to tell, whether it happens in the same way on other planets, whether it happens in such way on high mountains, etc. But here the law from empirical became derivative because it has been found, that the raising of water in the pump is caused by pressure of an atmosphere. The empirical law has been explained. As soon as it has happened it was possible to determine the exact borders of applicability of this empirical law. We now know where this law will not have application. We know, that at tops of high mountains the height of raising of water in the pump should be below 33 foots, that other liquids as, for example, mercury, a sulfuric acid, etc., will not rise up to this height. Any of these restrictions could not be received empirically. Transformation of the empirical law into derivative has resulted immediately to all to these restrictions.

Deductive opening of laws. Deductive opening of laws happens when action of one reason mixes up with action of another (for example, on any body operate two forces under an angle; it is required to determine a way which will the given body go). In this

case sometimes it is necessary to determine, what action from a combination of the given reasons can occur.

In application of this method it is possible to distinguish three moments.

The first moment is a finding of the elementary laws of the separate reasons by means of an induction. By means of an induction the laws of the separate reasons are determined which, entering into connection with each other, make the known action.

The second moment makes syllogisation, i.e. deducing, from already known laws, of the separate reasons of that combination of their actions which is necessary for creation of the researched complex phenomenon. Deduction in the true sense consists in definition by laws of the separate reasons what kind of action it would be if it is made by a combination of these reasons.

The third part is made by check of calculation, or a conclusion, by means of comparison of results of calculation with supervision of the investigated complex phenomenon. It is comparison of action predicted and the given action.

To explain application of a deductive method for opening of the laws of the nature, we shall examine a task: define which way will make a kernel during its flight from a barrel of a gun.

By means of inductive researches we know elasticity of the gases developing in a barrel of a gun; inductively we know the power of resistance of air and, similarly, the influence of terrestrial gravitation.

Having these data, we use the deductive method for the solution of our task. By means of syllogisation we define the power of resistance for the given case (for this purposes the general provisions and the given special case is necessary for us). By means of syllogisation we determine, what kind would be a line of flight if only one elasticity of gases worked. Taken into account these and other data, we determine a line of flight.

Then it is necessary for us to make a check. For this purpose we fire the kernel from the gun and in such way we check, whether our conclusion was correct.

Thus, by means of syllogisation we are able to determine, what action will follow after the given combination of the reasons.

From the stated it is obvious, that deduction is important for disclosing laws of the nature. From stated in this theme it is easy to see that exactly the connection of deduction with an induction enables to open laws of the complex phenomena. To the deductive method characterized in the specified way, with its three components: an induction, a reasoning and check human mind is obliged by the most brilliant victories over research of the nature. We are obliged to it by all theories bringing the extensive and complex phenomena under some simple laws which could be never opened directly.

Questions for revision:

1. In what two cases the deductive method is used?
2. What does the deductive explanation of laws consist of?
3. What is the distinction between empirical and derivative laws?
4. What there are three kinds of a deductive explanation of laws?
5. What does the deductive opening laws of the nature consist of?

Topic 20. ABOUT THE HYPOTHESIS

The role of hypothesis in science. Some scientists believed that sciences develop only with the help of gathering facts. To their mind, facts and experiments are primary things for science, and the scientist should do nothing but register facts, i.e. merely describe facts, events, and phenomena. But actually this opinion is false. We must be directed by the known idea, known plan to gather facts and materials for science. In order to perform any experiment, we need to have a definite consideration or argumentation why we should carry out this experiment and not the other one. If we perform experiments on the off-chance, it wouldn't bring us to any positive results. This can explain "why alchemists contributed so little to our knowledge. A lot of them were clever and restless, work of such people continued for centuries, but they discovered a little; and a correct vision of the nature gives contemporary chemists the possibility to discover more facts during one year than alchemists have being done during several centuries". (Geavons) Therefore the science is created not by gathering facts on the off-chance, but by gathering them accordingly to some plan.

In order to have a plan we should build a hypothesis. But what is hypothesis? **Hypothesis is assumption, which we consider to be truth to derive consequences concordant with existing facts or with other approved theses. The concordance with facts or approved theses serves as proof of the hypothesis.**

When do we use hypothesis? When we have a range of facts that are not explained only because in a direct experiment we don't have enough of data. In such a case we have to supply the experiment data with something not given directly in the experiment. This supplement is made with the help of assumption or hypothesis.

The process of hypothesis building is alike with abovementioned deductive method of working out laws. The difference is following. In the process of working out hypothesis the first part of deductive method is absent, that is we lack induction with the help of which the law is established. But

hypothetical method is quite alike to deductive in the way of using the technique of syllogisation and prove. The law itself that leads to the conclusion, is taken as truth instead of being proved as it is in deductive method. Obviously the hypothesis can be viewed as truth on condition that it leads to true results.

In the process of building hypothesis we can distinguish 3 stages:

1. We make a known assumption.

2. We make one or several consequences from the assumption.

3. We check if the consequences correspond with reality or other assumptions proved.

Let's consider the hypothesis of universal gravity in order to understand how a hypothesis can be proved by its own consequences and real facts. It is well known that accordingly to gravity hypothesis, "all solids gravitate to each other with the power dependent on their mass and distance between them". Accordingly to the hypothesis all solid fall down on the ground; correspondingly all heavenly bodies gravitate to each other. Let's look how the hypothesis is proved.

Let's consider the first consequence of the hypothesis: solids falling down on the ground. Obviously there's nothing simpler than the statement that all bodies fall down on the ground. Though the ancient Greeks didn't believe it right because they happened to see flames, steam, and smoke ascending.

Basing on this Aristotle and other Greek philosophers assumed that some things are heavy in their nature and they rush down, and some things are light and they rush up. But Newton proved that the statement is wrong. There is no light or heavy things in nature, all bodies even so called light ones rush down: steam and smoke though ascending subdue to the law of gravity.

In order to understand it let's pay attention to the following. If we put a pound weight on one scale of the balance, and a half-pound weight on the other scale, the latest will go up. The fact that a half-pound weight goes up doesn't mean that it doesn't submit to the gravity law. If we put a piece of iron in the bottle with water, going down it will make some part of liquid go up. If we put a cork in the water, it will aim down but like a scale of abovementioned

balance it will go up. It doesn't mean that a cork is not rushing down: it is pushed out by some other object that is rushing down with much force. This makes obvious that flame, steam etc. go up because they are lighter than the air surrounding. That's why Aristotle was wrong thinking that there are some bodies that thanks to their nature go up. In fact even these bodies aim down. Therefore if we suppose that all bodies gravitate to each other, this should mean that all bodies fall on the ground. Indeed the conclusion from the supposition agrees with facts: all bodies aim to fall down.

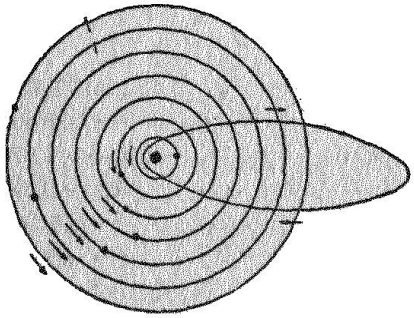
Let's consider the second consequence. If all bodies gravitate to each other, all bodies should gravitate to the Earth. The Moon is a body, and it should gravitate to the Earth, i.e. to fall down on the Earth. Why doesn't the Moon fall down on the Earth and keeps on rotating around it? According to Newton's theory, the Moon really aims to fall down on the Earth; otherwise it would have to move at a tangent line to the orbit thanks to the centrifugal force. After calculating Newton proved that if the gravity is the same as he thinks, the Moon should move by the Earth the way it already does. He also showed that the planets should rotate around the Sun as they do.

We derived two consequences from the hypothesis of general gravity (bodies falling down and bodies moving), and both these consequences appeared to reflect the reality. Consequently the hypothesis agrees with facts; it explains the latest ones and consequently id proved by them.

Experimentum crucis. Sometimes it happens that two or even three absolutely different hypotheses seem to agree with obvious facts, so it's hard to choose the true one. In this case our task is to find a fact that agrees with only one hypothesis and conflicts with the rest. The finding of such a fact is called experimentum crucis.

To explain the motion of the Solar system planets Descartes supposed that there is some vortex that carries away all planets around the Sun in one direction. To explain this let's take a glass of water, in whish there are small parts of a cork. Then we make a

movement inside, for example stir with a spoon. The whirlpool appears, and all parts of water and cork move in one direction.



The same way, according to Descartes, the planets flow in the universal space because the move in one direction after they have been set in motion. But Newton's hypothesis of gravity explained the same facts the other way, and it was hard to choose the right one. That's why it was necessary to discover a fact that would agree with one of the hypotheses and conflict with another.

Such a fact appeared. It was Newton who proved that the motion of comets doesn't agree with Descartes' theory. Comets move not in the direction all planets move, they go through all circulation of the Sun (look at the scheme). If Descartes' theory was correct, the comets should move the same way as planets taken with the common vortex.

This fact disproved Descartes' theory. But it agreed with the general gravity theory.

We overviewed the scientific importance of the hypothesis. It's obvious that a hypothesis is acceptable only when its conclusion agrees with facts.

It should be mentioned that a hypothesis possesses only bigger or lesser degree of possibility. The possibility of a hypothesis can turn into reliability when we manage to prove that the hypothesis is the only explanation of a phenomenon and if its conclusions agree with other accepted facts, i.e. with already proved facts. Such a hypothesis is said to be proves; proved hypothesis is called a theory.

A hypothetical method is used in science about the nature, about the society (in history, history of art, linguistics, history of literature). For example the hypothesis about origination of this or that people (origination of Varangian), hypothesis of belonging the masterpiece to this or that author. A hypothesis is also used in court

trials. On the basis of attestations which sometimes are not full, we rebuild the events with the help of different additions. Then we look if our supposition is proved by any data.

Questions for revision:

1. How a hypothesis is defined?
2. What is common and different for the method of deductive discovering of laws and hypothetical method?
3. What is experimentum crucis? Explain the relations between a hypothesis and a theory on the example.

Topic 21. ABOUT THE PROOF, THE METHOD AND SYSTEM

Proof definition. We have already had a case of usage a concept of the proof in connection with a concept of conclusion. Now we are going to give its definition and we will specify the distinction between the proof and conclusion.

We know, that judgements can be directly obvious, or they can become obvious if we reduce them to positions, the character of which is directly obvious. If we make judgements obvious by means of such reducing we can tell, that we prove them. This reduction to evidence acquires a syllogistic form so the proof can be defined as deducing of any judgement from other judgements considered to be true and obvious.

Thus, the proof in general has the formula of syllogistic conclusion, but there are essential points of difference between conclusion and the proof.

Particularly in conclusion we do not always pay attention, whether sumptions are true; in the proof the validity of sumptions is the most important requirement. Besides, the difference between the proof and syllogism is that the proved judgement corresponding to the conclusion of a syllogism, is known in advance.

In any proof we distinguish three parts: 1) proved position, or the thesis; the very thing that should be proved or made obvious; 2) proof bases, or arguments; the thing by means of which the thesis is proved or becomes obvious; 3) the form of the proof, or the way in which the thesis is deduced from arguments. The thesis of the proof corresponds to the conclusion in a syllogism. Arguments correspond to the sumptions of syllogism. The form of the proof is the logic scheme with the help of which the conclusion is deduced. For example, it is necessary to prove, that «iron can be smelt». This is the thesis. To prove this we should use the following two arguments: «all metals can be smelt», «iron is metal». Having constructed the syllogism, we will prove the thesis.

Main principles and axioms. So, the proof is reduced to disclosing the evidence of the given judgement from the evidence of other judgements which are called arguments. And if the last are not obvious how to act in that case? It is necessary to prove them by means of any other arguments. But as the last also can be doubtful the proof mostly represents the whole chain of conclusions. Eventually any proof should lead to such positions which already have indisputable or obvious character. These last are **the** essence **of the axiom**, or these are conventional general provisions which in that case are called **main principles.**

Direct and the indirect proof. The process of demonstration can be direct or indirect. In the direct proof we deduce the validity of the thesis from the validity of arguments by means of conclusion; indirect, or apagogic proof deduces the validity of the thesis from impossibility to suppose or admit the validity of the position contradicting the thesis. We take the position contradicting the thesis in the indirect proof and we assume its to be true (such position is called antithesis). Then from this position, we deduce consequences which lead to the contradiction with the given or admitted positions. As a result we have to reject the validity of contradicting position which we have presumably admitted; from this will follow the validity of the thesis. So the thesis is proved.

Let us take an example from mathematics. It is required to prove, that in a triangle in which two corners are equal, opposite sides to them are also equal. Suppose in a triangle ABC the corner *a* is equal to a corner *b*, and opposite them sides are AC and BC. We need to prove, that AC = BC. It is the thesis. Let us take the situation contradicting the thesis: «AC is not equaled BC». This is antithesis; then from this last assumption (according to the theorem, that in any triangle there is the biggest side against the biggest corner) will follow, that the corner *a* can be either more, or less than corner *b*. But as the conclusion contradicts the position accepted by us the antithesis is false. Then the position contradicting it, the thesis should be the true. Such a proof is called also *reductio ad impossibile* or *reductio ad absurdum.*

Concept about method and system. For achievement of some purposes in the process of thinking one or another judgement or a number of judgements should be situated in a certain order, accordingly to certain rules. **This order of arrangement of the judgements, promoting achievement of definite purpose, is called method.** As we have already seen to prove existence of causal relationship between the phenomena, the judgements should be situated in one or another order: or according to a similarity method, or to a difference method, etc. The concept "method" is used either in relation to physical processes. For example, it is possible to learn swimming being supervised by certain rules – this is a methodical training. But it is possible to study without any rules – this is nonmethodical training.

The system is a connection of the interconnected phenomena in a unit. Judgements, as well, can be connected in such a way to make a unit; in this case they form "system" of judgements. The system of judgements makes a science. **The science, thus, is set of authentic, or at least probable regularly located judgements .**

The scientific thinking should be carried out accordingly to certain rules, i.e. on a certain method. In scientific thinking the method can be applied in two various cases: firstly, in opening of new truths and, secondly, in a certain arrangement of already opened truths as it happens in a statement of scientific data for their clearest understanding. Analytical and synthetic methods both serve to open and state scientific truths.

The analysis and synthesis. To understand, what these methods consist in, we will notice, that a particular position, a conclusion, a consequence is in the same relation to the general provisions, principle, basis that action is to the reason. As from the known reason forms the known action so from a known principle, basis forms the known conclusion, the consequence. In a way we're searching a principle or a basis for a known position, we're searching a reason for a known action. On the other hand, in a way we're searching an action for the known reason, we can search consequences for known principles.

Hence, depending on that what we're searching, two various processes turn out.

If we go from the reason to the action, from the basis to the conclusion such way is called progressive or synthetic. It is called progressive because it corresponds to a real course of the nature, the valid course of things, since in the nature the reason is earlier, than the action. The way back, from the action to the reason, from conclusions to principles, is called regressive, analytical.

The relation scheme between the analysis and synthesis

Words "analysis" and "synthesis" are often attached with other meaning, and analysis is a method of decomposition of the whole in its components, and synthesis is inversed method of composing the whole from its parts, or elements. In this sense they often speak about the chemical analysis and synthesis. But to understand the true sense of concepts "analysis" and "synthesis" as they are used in scientific researches and statements, it is necessary to consider data of private conditions to main principles as a major meaning of a word "analysis" what we have just specified, and it is necessary to understand synthesis as deducing of consequences from main principles.

We use analytical method of research when we are searching for the reasons of the given actions. A judge, a moralist and those others who are searching for the reasons of the certain actions, use analytical method; a legislator, a politician, a teacher who are trying to provide for actions of the certain reasons, should synthetic method.

To explain application of analysis let us give such example. To do a sum of drawing a rectilinear hexagon into the given circle, we can use this line of reasoning. Let us assume, that the problem is solved, and let AB is one of the sides of the hexagon. If we draw radiuses to final points of the sides the triangle formed thus, will be equiangular (as each angle is equal to two thirds of right angle); hence, the side of the drawn rectilinear hexagon is equal to the radius. So, to enter a rectilinear hexagon into a certain circle, we should draw radius six times on a circle. Here application of an analytical method is obvious. Having assumed that the sum is done, i.e. having supposed the given particular situation, have found the

condition, the general principle under which this particular situation is possible i.e. from which this position can be deduced. In other words, we reduce the given particular situation to a general principle.

As an example of application of synthesis we can use the theorem: «in any triangle the sum of its angles is equal to two right angles». To prove this theorem we should accept the following two general provisions: «interior crosswise laying angles are equal» and «any pair of adjacent angles is equal to two right angles». We deduce required provision from these general provisions.

The relation of the analysis and synthesis towards induction and deduction. But, what is the relation between analytical and synthetic methods towards inductive and deductive methods? The relation between them is that, analysis corresponds to induction, and synthesis corresponds to deduction. It is easy to explain that analysis corresponds to induction, it is easy to explain so.

The aim of induction is to discover laws, general principles. In the course of an induction we go from certain statements to the general principles. Therefore in course of induction we make a regressive way. It follows, that the induction corresponds to the analysis.

On the contrary, deduction infers certain statements or other consequences from general principles. So we can trace relationship of deductive method with synthetic one. Synthetic method is that we assume certain principles as already discovered and proved. Then we deduce consequences from these general principles.

Questions for revision:

1. What is the proof and how does it differ from a syllogism?
2. What are the main principles of the proof?
3. What proof is called a direct proof?
4. Expound the course of the indirect proof?
5. What methods are called analytical method synthetic method?
6. Why is synthetic method called progressive one, and analytical – regressive?

Topic 22. ABOUT LOGICAL ERRORS

It is usually accepted to divide logical errors into two groups: logical errors in it's true sense and errors occurring owing to mistakes in verbal expression of thought. In the first case the error is in blunder of logic process, in the second one – in blunder of expression. One of verbal expression errors is the following:

Homonymy – an error which occurs when one and the same word serves for a designation of various concepts, i.e. is used in various meanings. For example, they think, that philosophical "rationalism" is the same, as practical "rationalism". In this case there is a mixture of concepts owing to mixture of words. Other errors occurring owing to mistakes in verbal expression of thought, are specified in grammar.

To understand, why logical errors receive this or that designation, let us recollect a designation of parts of the proof. In proof we distinguish: thesis, arguments and form of a proof. Errors can be in relation to each part of the proof. It is clear, that if false arguments are taken the error will turn out; but the error can happen if the form of conclusion is wrong.

Deductional errors. Logical errors can be related to thesis. If proved the thing that was not required to be proved, such substitution of the thesis is called ignoratio elenchi (elenchus means a refutation of any argument, and ignoratio elenchi means ignorance of that syllogism which can deny the opponent). For example, if it is necessary to prove, that something is unfair in a moral sense, and somebody would began to prove, that it is unfair in legal sense he would prove one thing instead of another though also similar. If something what is proved differs in origin from the thing that is necessary to prove it is an error «transition into other origin». It will take place in the case when somebody intends to prove innocence of the accused by the fact that others have committed the same crime, but avoided punishments.

Deviation from thesis can occur as well in the sense that thesis is proved but not enough, so part of it remains not proved, or it is proved too much, so from the given bases follows not only the thesis, but also any false point. Such erroneous proof is called: qui nimium probat, nihil probat («he that proves too much, proves nothing»). For example, to prove the point that the sum of angles of a triangle is equal to two right angles, to prove that this sum will be no more than 180 ° wouldn't be

enough (there are few proofs). If we wanted to prove, that somebody is virtuous, and thus would began to prove, that nothing bad is known about him by this we would prove too little. Proving inadmissibility of suicide on the ground that a person can not take away from himself what he has not given to himself, proves too much because it proves, that he cannot cut nails, hair, that he cannot sell inherited or received in a gift, etc. Therefore here the thesis, actually, is not prove. As it is easily seen, such erroneous proof turns out in the case when points which appear false at the given degree of a generality but which could be true at smaller degree of a generality are given.

It is necessary to refer the error occurring owing to usage the method called **argumentum ad hominem** («argument to the person», i.e. personal, instead of objective argument) to the same group of errors. It is used when, instead of proving falsity of any opinion, the person who has expressed this opinion is under consideration. For example if somebody wants to prove groundlessness of the scientific theory of a writer and instead of analyzing critically the theory of the author, reveals membership of the author of unpleasant for readers political party he uses argument ad hominem. This proof, logically the weakest one, actually has the big success.

In relation to the bases of the proof, or to the arguments, there can be following errors.

The basic error, **error fundamentalis**, – a false substantive point on which any proof and from which various conclusions can become. For example, the basic error in astronomical reasonings before Copernicus, was the argument that the Sun and stars go round the Earth.

The error **petitio principii** («basis anticipation») happens when to prove a point we take as a basis another one which assumes the first one to be true. Somebody wants to prove the thesis: *«All parts of substance have the same weight»*.

Answering the question why does he think so, he could give following basis of the proof:

«If we take two objects with identical volume the heavier body has bigger number of parts, i.e. bigger weight depends on quantity of parts».

Answering the question, whence is it known, that bigger weight of a body with identical volume depends on quantity of parts, he will answer:

«If to take into account, that all parts of substance have identical weight it will become quite obvious, that the heavier the body, the bigger number of parts it contains at identical volume».

In this example the thesis is proved by means of the point, which itself can be proved at an assumption of the validity of the thesis.

Thus, talking about the error petitio principii we accept for the true the point, which itself should be proved.

Idem per idem («the same through the same») and circulus in demonstrando («a circle in the proof») are related with petitio principii errors. The error **idem per idem** happens when a position is proved by means of the very same position. For example, answering the question why we can look through the glass, some people say: because it is transparent. But it is obvious that to name substance transparent means, in other words, to say, that it is possible to look through it. **Circulus in demonstrando** is the kine of error when thesis ***A*** is proved by mean of argument ***B*** which can be proved by mean of argument A. Foe example, we assert, that the story of a writer is true, because he is upright. Answering the question: «How do you know, that the writer is upright?», we say: «It is proved by the content of his stories». So we have made a circle in the proof.

Independently there are following errors:

The error **a dicto secundum quid ad dictum simpliciter** («from the told in relative sense to the told irrelatively») arises in case when the expression taken in conditional, relative sense, is accepted then in sense unconditional. For example, arsenic, strychnine, hydrocyanic acid, being injected into an organism in a significant amount, cause death. In this case we are talking about these substances in conditional sense, i.e. we are talking about their toxicity when they are injected into an organism «in a significant amount». But if we have said, that they always cause death we would make a specified error because in very small doses they are not deadly and, it is well-known, are used as medicines. In the second case we have rejected the condition which we specified in the first case.

The error **fallacia a sensu composito ad sensum divisum** («an error from collective sense to dividing one») occurs owing to mixture of the collective term with the term the general one. When we use a general term the fair concerning the whole class designated by the general term, is fair concerning each individual entering into this class; but when we use the collective term it can be unfair. The fair concerning the whole, designated by the collective term can be unfair

concerning the parts entering into this whole. For example, a society in which I am a member, has made a decision deserving censure. If someone will reproach me for this decision as well he will make an error fallacia a sensu composito ad sensum divisum for this statement, fair concerning a society taken as a whole, can be absolutely unfair concerning separate members of this society who could give the vote against the specified decision.

Fallacia a sensu diviso ad sensum compositum («the error from dividing sense to collective one») happens in the case when we assert about collective whole the very thing that is fair only concerning parts of this whole. Here there is also a mixture between the term the general and collective. In general concepts what we cannot say about an individual of this or that class, we cannot confirm about the class. In collective concepts, on the contrary, we can confirm about parts of the collective whole a lot of such statements that we can not confirm concerning the whole. For example, somebody, discussing his expenses, can say: «This expense will not ruin me», and about another one: « And this expense will not ruin me ». If he discusses in such a way all other expenses he'll have to admit, that all expenses will not ruin him, that will be erroneous: the thing that is fair concerning each expense taken separately, can be absolutely unfair concerning all expenses taken together. Other example. The patient wishes to define, whether his illness is lethal or not. Having considered each symptom separately, he thinks, that each symptom separately is not deadly; from here he makes a conclusion, that his illness is not deadly. But this reasoning can appear wrong because each symptom separately can be not fatal, and all as a whole can be fatal.

Mistakes of induction. To the mistakes connected with induction, concern first of all hasty generalisations (**fallacia fictae universalitatis**). When travellers after a superficial acquaintance with any people do attempts to characterise them, for example when they say: "Greeks are deceitful", "Turks are severe" etc. they make a mistake of hasty generalisation. The mistake **post hoc ergo propter hoc** («after that means because of it») is called also as an error non causa pro causa («that is not the reason, to the reason»). If somebody has noticed, that after an event there is an action he considers the first event to be a reason though actually, maybe, there are events from which the given event is in greater dependences and which actually is the true reason of the given action.

When after comet appearance there were any misfortunes ordinary a comet considered as the reason of these misfortunes. When in a tube there was emptiness and water in it rose up, they thought, that emptiness was the reason of raising water. If after introduction of any form of government there are any events these forms of government are considered to be their reason, meanwhile the true reasons, maybe, consist in something else, for example in certain degree of intellectual or moral development of a society.

There are cases which especially predispose to those or other conclusions. Usually it happens when we have for some reason or other an intention to remember the cases confirming one position, and to forget the cases denying this position. If the prediction of any calendar once comes true, uneducated people are inclined to have in this case confidence in truthfulness of predictions of this calendar, absolutely losing sight of one thousand cases in which its predictions did not come true. The belief in various foretellers, charlatans is based on it, etc.

It is necessary to make some examples of mistakes **of simple transfer induction**. Some people often say: «the majority of women in the past was not equal to men in energy and mind; therefore it is necessary to admit, that women in general are beneath men». But the statement, that in the past the women intellectually were not equaled to men, is fair only for actual time and under actual circumstances. In other time and under other conditions everything can be absolutely different. A simple transfer mistake is a statement that war always will be between the nations because till now it always was.

Analogy mistake. In materialistic philosophy as an example of false analogy usually a conclusion according to which political bodies, like organic ones, have young and mature age, old age and death is taken. An analogy mistake is the statement that ants have slaves, soldiers, pets, etc.

Sophisms. Mistakes made unpremeditated, are called **paralogisms**, and those made on purpose to mislead someone, are called sophisms. Let us show examples of sophisms going to us from antiquity.

1. Sophism "liar". Quite probably, that the liar will confess that he is a liar. In that case he will tell the truth. But one who tells truth, there is not a liar. Hence, probably, the liar is not a liar. (What is the mistake?)

2. Sophism "horned". What you have not lost, you've got; you have not lost horns. Hence, you've got horns. (What is the mistake?)

3. Sophism "pile". Whether a pile of sand from which we took one grain, will be considered a pile? Yes, it will. And if we take one more grain of sand? It will. If during consecutive taking on one grain of sand the pile does not cease to be a pile it is necessary to name one grain of sand a pile. (What is the mistake?)

4. Evatl's sophism. Evatl took lessons of sophistics from sophist Protagoras under the condition, that he will pay the fee only in case he will win the first process. The disciple after training did not take any process and that's why considered himself to have the right not to pay the fee. The teacher threatened to make the complaint in court, telling him the following: «Judges either impose a fine on you, or will not impose. Any way you'll have to pay. In the first case owing to a sentence of the judge, in the second case owing to our contract». Evatl answered: «Neither in that case, nor in other one I will not pay. If a fine will be imposed on me I, having lost the first process, will not pay owing to our contract if a fine will not be imposed on me I will not pay owing to a court sentence».

The mistake becomes clear if we separately put two questions: 1) whether should Evatl pay or not and 2) whether terms of the treaty are executed or not.