Text 5 (Poincaré) Annotation

There are two difficulties in the text: (1) The author looks science from an abstract angle, lacking of examples. (2) There are many minor matters which seem to be unrelated to the theme, showing the author's personal style. In fact, the annotation has not been completed and it is just the first edition. It is hoped that you will kindly point out the errors.

I. Selection of Facts

Para. 1-3: These three paragraphs are slightly off topic. Paragraph 1 responds to the topic, pointing out that facts are infinite so that it is necessary to select. Two principles of selection are then proposed: (i) purely caprice (having the meaning of short-term desire); (ii) utility. In paragraph 2, he discusses the view of Tolstoi (the first name in the first paragraph) towards utility. He indicates that the utility perceived by Tolstoi is not the same one which is industrial applications perceived by businessmen. Instead, it means making men better. Just when we think that the author would choose one of the views of Tolstoi and the merchants, he says: I could not be satisfied with either of these ideals. He indicates that the two views are actually like plutocracy and democracy and selecting either one is just a matter of taste.

Para. 4-5: 'Nonetheless the question remains' indicates that the author turns back to the theme. First he says, 'if selection is only determined by caprice or immediate necessity, there will be no science. He asks, 'Is this true?' It does not seem to be a rhetorical question and the answer is yes. (If it is a rhetorical question, the answer will be 'no'.) Therefore, the author first indicates in paragraph 5 that the third possibility apart from caprice and immediate necessity: a hierarchy of facts.

The author thinks such hierarchy does exist and the evidence is the success of industry. The author did not forget to accuse businessmen in an ironic way, calling them 'practical men'. If not those disinterested fools (that means scientists) contributed, then it would merely depend on these practical men, and industry could impossibly have been developed (would never have seen the light).

Since the author does not explain what “a hierarchy of facts” mean, we need to make a guess. There are two possibilities: 1. Some facts are related to each other, can be categorized. For example, some facts belong to natural science, social science, humanities; whereas some of them do not have associations with others, belonging to miscellany. Different hierarchies of facts imply different categories of facts. 2. Facts which can be categorized would have different hierarchies. Some facts are more directly perceptible. For example, we can observe the time, distance and weight of a falling object. When scientists investigated the relationship among the time, distance and weight, they found out the concept of ‘gravity’. To scientists, gravity is a fact, not being directly perceptible but being abstractive.

Para. 6-7: The author showed his personal style to the utmost. The first sentence has a ‘fool’ (referring to the previous paragraph, meaning scientists) and he does not forget to tease about ‘Now the majority of men do not like thinking’, following their instinct. He indicates that ‘this is perhaps a good thing’. If we need to pursue ‘an end that is immediate’, it is better than ‘reason would guide a pure intelligence’. But instinct is routine and men cannot acquire improvement depending on it. At the end of the paragraph, the author points out that what make men improve are those useful thoughts. The meaning of ‘useful’ implies generality but not practicality. This smoothly connects the ‘recurring facts’ in the next paragraph.

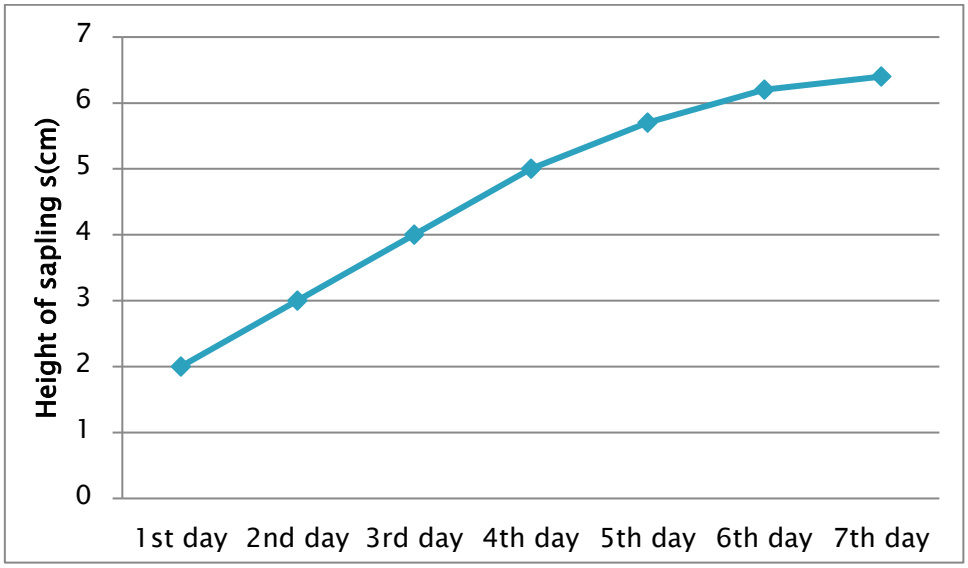
The author started to explain the implication of ‘recurring facts’ in paragraph 8, but he made a very interesting comment in paragraph 7. He said that there were only 80 elements in this world fortunately (there are more than 120 elements in the current time than Poincaré), but not 80 million. Otherwise, the elements of different things are absolutely different and it is difficult to find two identical recurring facts. Life is also difficult to exist because everything in the world is different and life could not adapt to the environment. Even if there is life, there will not be two similar individuals and the concept of species will become meaningless.

Para. 8-9: The first sentence indicates that recurring facts are ‘simple facts’ and ‘simplicity’ consists of two implications- the first type is ‘real’ simplicity and the second one comes from elements that are “so intimately mingled that they do not admit of being distinguished”. An example of the first type

is elements- there is a piece of gold in front of you and there are a lot of gold atoms in it. Each of it is a real simple fact. For the second type, we can use air as an example. Although air is not an element, any small parcel of air has the same proportion of oxygen, nitrogen, carbon dioxide and other rare gases, so it is simple. A raisin cake is not simple. Some parts of the cake are raisins, some are flour, not completely mixed so it is not simple.

Para. 10: This paragraph is easier to understand, but the author is suspected of making fun of sociologists. In the last sentence, he says that sociologists obtain fewer results with many methods and their authors are very careful not to apply.

Para. 11-12: This paragraph is the speech of 'insider'. To understand paragraph 11, we must first review a learning experience in junior high school – doing measurements, plotting data points on the xy diagram and then connecting the points with lines (assuming the experimental errors can be ignored). For example, the following diagram shows the growth of saplings:



The author points out that the practical man is only interested in the immediate utility so is only willing to observe the part. For example, he may only be interested in the initial growth of the saplings because he is too anxious to sell, so the experiment lasts only two or three days. He only knows the left side of the figure, thinking that the height of the saplings definitely rises straight up. Scientists hope to have a comprehensive understanding, so the distribution of data points is broader and more even.

He knows that only the initial growth of saplings can be described by straight lines. In the later stages when the growth rate slows down, curve lines should be used.

The first sentence of paragraph 11 says, 'the facts which are in complete conformity with it lose their interest, since they can teach us nothing new.' It can be imagined that if the growth of the saplings has not deviated from the straight line, then no moment of development is unexpected and of course there is no interest. However, when the speed suddenly slows down, the situation will be interesting and we will ask why. Therefore, it is the exception which becomes important.

If we understand paragraph 11, paragraph 12 is easier to understand. Scientists are hoping to find data that are inconsistent with the existing theories. Even if the data only slightly deviate from the existing theories, they can tell us new things.

Para. 13-14: This paragraph is a brief summary and after this the author converts to a new topic: intellectual beauty. The author concludes in the first sentence of paragraph 13 that the purpose of scientists is not only to find out the similarities and differences among things, but also to discover the similarities hidden under the differences. Here are two examples:

Example 1: The former people (for example, Aristotle) thought that the objects on the ground and the celestial bodies obeyed different laws, and later learned that both of them obeyed Newton's laws.

Example 2: Previous people thought that the phenomenon of discharge and the phenomenon of attraction between magnets are completely irrelevant. We now finally understand that they all belong to the same set of theories: electromagnetic theory. According to this theory, electricity produces magnetic forces (such as electromagnets), and magnetic forces can also generate electricity (such as generators).

In paragraph 14, the author says that the scientist 'tries to condense a great deal of experience and a great deal of thought into a small volume'. This small volume is a metaphor for a concise physical theory. Because

physical theories are brief but they can explain many daily experiences and concepts, these experiences and concepts seem to be condensed in theories.

Para. 15-17: The author begins a new topic, which is 'intellectual beauty'. Intellectual beauty is different from beauty which strikes the senses (paragraph 15). The sense of the harmony guides people to pursue this beauty (paragraph 16). In paragraph 17, the words 'vastness' and 'vast facts' suddenly appear. The author is not trying to introduce new concepts, but to highlight the other side of simple facts. Simple means that the nature of these facts is the same, showing one of two kinds of simplicity (paragraphs 8-9). Vast describes these simple facts as widely distributed and far-reaching.

Para. 18-19: Exploring why beautiful things are also practical. In the 18th paragraph, the author utilizes architecture as example and points out that beautiful buildings are also practical, and the beautiful columns have supporting functions. In paragraph 19, the author proposes two possibilities: 1. The things that happen to be beautiful are the easiest to grasp by intellectuality; 2. Natural selection—the war between the Greeks and the barbarians.

Para. 20-21: Mentioning Tolstoi and moralist is the author's personal style, and the motivation for mentioning a moralist is unknown.