Pluralism in the "Tears of Wine"

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Recently, many people say, American students are changing greatly. They shy away from dispute, and they tend not to display their assertions. Furthermore, these stories report, the students of the so-called elite universities are more inclined to this tendency. It would not be so curious if this had started after 9/11, the time when people were threatened by the words "Watch what you say!" But this tendency was obvious even before. It has been found in Japanese students for a long time. However, it has now also appeared among the students in US, the country of avid debate. I wonder: is this a serious social problem that symbolizes today and the future?

What is the basis for this tendency at all? The current backbone of students' affairs, for students who are fully intellectual and well educated, and who are from the top universities, seems to be post-modernism, and the pluralism that occurs as a consequence of post-modernism. I am even not modern yet, and therefore hesitate to mention the post-modernism that comes after the "modern". However, simply interpreting, the core of the idea seems to be: "You are you, I am I", "Both way of lives have their own values", and "Let's accept our opinion each other". You might say, in other words, "It is dangerous to insist on one idea, one viewpoint." Such a way of thinking might be reasonable. However, in scientific fields, this is quite a bother.

We, people in different worlds, have enabled our communication and accumulation of knowledge by describing an idea with our common language. People have often expressed an idea in different words, and different ideas in same words. This problem has been, however, solved in the long history. Have you ever had such a disgusting experience: when you criticize a speaker in a conference, you receive as an answer, "It is a semantic problem. You and I are different from the beginning, with the definition of our words"? It may not happen so often in science, unless someone uses such a response to avoid a troublesome assertion. However, even in the field of science, away from a dictionary of nomenclature, discussion becomes obscure.

Today's subject is of wine. Wine is a truly glamorous liquid. Not only it is delicious to drink, it also has so mysterious a power as to have one of the most popular novelists write an absurd story about a man and a woman who commit a double suicide by drinking a poisoned Chateau Margaux, (what a waste of precious wine!), and to deprive a famous woman poet of her lyricism and delicate sensibility, according to one newspaper account. A title starting "Wine is …" certainly attracts people by itself. I am not purposely using this ruse, but I will also recount here a story for a better understanding of wine, specifically, "the tears of wine".

When you charge a glass with a high-alcohol wine, and let it sit for a while, liquid crawls up along the inside of the glass, higher than the original level of the liquid. It reaches a certain height and then becomes a droplet and slides down. I have thought for a long time that this phenomenon is called the "tears of wine", and that normal wine doesn't perform such a show. However, in a recent seminar, I heard that a "tear of wine" is a droplet slipping down along the glass wall after you turn a glass to let the liquid touch near the edge. "No!" I said in my mind. "This story doesn't strike at the intimate interest of this phenomenon." Wine creeps up the wall of the glass against gravity before it runs down; this arouses our curiosity. It is natural that things drop. It is much less interesting if you raise them intentionally and then let them drop. Here an idea flitted through my mind: this might be also a semantic problem!

After that, I looked through some literature at my odd times. In a classic textbook "Soap Bubbles" (1) that introduces some experiments of surface chemistry for young people, the author Boys mentioned, with the Figure 1, that the tears of wine is a phenomenon observed with high-alcohol wine, stating "with strong wine such as Port wine." He then explained this creeping phenomenon was caused by the difference between water and alcohol in their volatility and surface tension. Wine at the wall becomes, as alcohol is evaporated, rich in water, resulting in higher surface tension that draws rich-in-alcohol, and thus low-surface tension, wine upward. This interpretation of the "tears of wine" (2) seems to describe the phenomenon properly. Wine with the higher alcohol concentration exhibits a more pronounced creep.

Figure 1. The tears of wine
(C. V. Boys, *"Soap Bubbles"*, Dover, p.33, (1959))

Such phenomenon is not so rare; you may be aware of it if you have enjoyed Port wine or brandy. It seemed to be already of interest a long time ago. In the Bible, it is quoted in Proverbs 23:31, "Look not thou upon the wine when it is red, when it giveth his colour in the cup, when it mouveth itself aright (3)," which seems to refer to this phenomenon. If the creeping of wine is caused by the different volatility and surface tension between water and alcohol, one may easily be attempted to try various combination of liquids, not only wine or brandy. A series of these experiments were reported in detail by Loewenthal in 1913 (4). The title of his paper was "Tears of Strong Wine" and the

author stated at the beginning that "Wine with a high concentration of alcohol such as Port wine…creeps along the wall of the glass." Here the point is the automatic creeping of wine if its alcohol concentration is high.

Recent research, conducted with carefully cleaned glasses, reports that no creeping is found if the alcohol concentration is below 20%, unless the glass wall is wet. This is not in contradiction with the old research; the alcohol concentration of Port wine is indeed around 20%. However, the creeping phenomenon is not so simple, according to Cazabat, who reported this research. The wine doesn't show a uniform front when crawling up the wall of the glass. You will find ridges at certain intervals; the edges of which branch, especially when the angle of liquid surface and the glass wall is small, for example wine in a watch dish (5). The wine creeps as such, and eventually forms a droplet and falls (Figure 2). Thus, droplet formation is not explained simply by the Marangoni effect. A quantitative discussion is necessary to describe this phenomenon properly (6).

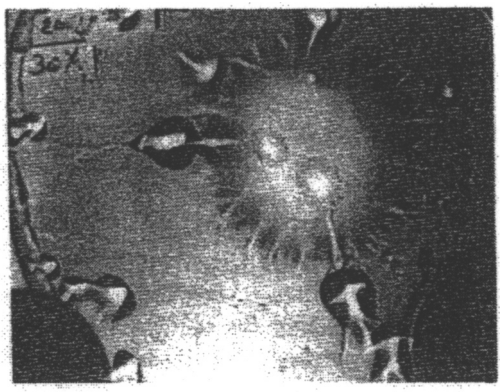

Figure 2.
Top view of a watch dish filled with 30-% ethanol.
(J. B. Fournier and A. M. Cazabat,
Europhys. Lett., **20** 517-522 (1922))

Then, excluding too precise a discussion, is it nonsense to discuss the tears of wine with normal, low-alcohol wine? The answer is not simple again. Normal wine in a glass forms a droplet like a tear. After rotating a glass, wine obviously slides in droplets like tears on the glass wall. Searching "the tears of wine" in the Internet, yahoo for example, 136,000 websites are hit (7). Taking a look on some of them, you will surprisingly find such an explanation "Charge your glass with wine. Rotate the glass for a while. Wine slides down along the wall in a droplet. This is called the 'tears of wine'." Furthermore, this droplet is also called "the legs of wine" in US, one of the web sites says. Mr. Robert Parker, who is famous for his reliable evaluation on wine, is said to state, "More luxurious wines show these tears more clearly. This is because they contain more glycerin" (8). The shape of the wine sliding on the glass wall may be seen like legs of a Rococo table. However, it does not fit the romanticism that wine creates, to say to yourself "Look! Beautiful legs! It is a precious wine exactly as I expected!" Is it a Japanese sense to feel that such expressions as a tears or a droplet fit more appropriately? In any case, there is no doubt that some people recognize the tears of wine either as the droplets that fall after you rotate the wine glass, or as the droplets formed on a pre-wetted glass wall.

I recall here that Cazabat excluded the case when the surface of a glass was wet. On the other

hand, Thomson stated in his paper in 1855, "Charge a glass with wine to half level. Rotate the glass and let the inside wet with wine. The wine remaining on the surface, shows curious behavior," referring to the case that you let the inside of the glass wet with wine at first. He did not limit this behavior to strong wine such as Port wine, as well. In addition, Loewenthal found that some moisture in air was necessary to see the tears of wine; it could not be seen when the air above the wine was dry (4). It is, therefore, an exception if the glass inside is wet. You cannot help wetting the glass inside even though you pour wine so carefully. Then you will see wine creeping upward automatically on the inside of the glass. Tears can also be seen; their shape is not very different from what you see with Port wine. If you pour wine in a washed and not dried glass, you will see that the wine moves more vigorously up the wall of the glass. A thin water film on the glass surface enables wine to creep easier; on the contrary, wine doesn't creep at all on a hydrophobic surface such as a poorly washed glass. Of course, wine carefully poured into a well cleaned glass neither creeps nor forms tears. The reports by Cazabat and others are certainly correct.

How then can we scientifically explain the phenomenon of the "tears of wine," which has been observed throughout history in at least two different contexts? Can we conclude that both interpretations are essentially identical? If so, a new explanation is necessary that encompasses both ideas. It seems to me that even though this phenomenon is well known, it is not so well understood. Careful experiments may be necessary. A dry glass, in a dining table experiment, surely has a monolayer or more of water on its surface, even if it's dry. Since such a glass surface doesn't allow wine to creep on it, a certain thickness of water layer is necessary for normal wine to creep. Does this thickness of water film correspond to what is necessary for water to have sufficient surface tension? To understand this precisely is not, however, a piece of cake. It may not be so easy as writing this essay; I currently hold a pen in one hand and a glass of wine in the other. How can you control the thickness of water film? The cleanliness of the glass is also a problem. You must not cleanse with abrasives, and washing with soap may be insufficient. Cleaning the glass in chromic acid solution, as Cazabat did, may be good but will leave the original surface roughness intact. Should we try to form the water film on a single crystal surface layer-by-layer? Considering this science on the molecular or atomic scale, the necessity of a huge amount of experimental designs, time, and money is clear, even for such a simple set of experiments to measure the contact angle at a perfect surface of the glass.

I am reminded now that we must also calculate the complicated phenomenon of wine creeping up a glass wall in the shape of a ridge. We can do it, but it may be too early to answer quantitatively more complicated questions such as "Why does the creeping wine separate from the glass wall and start to fall as a droplet?" Pluralism doesn't fit my policy in general, but, when I think of the tears of wine, I may perhaps desire nothing more than just enjoying discussions such as "Both ideas are interesting," "Different people may have different ways of thinking," "No, I don't accept it" and so on, while drinking wine with my students and friends.

Takashi Kakiuchi, June 2002.

Remarks and References

(1) C. V. Boys, *"Soap Bubbles –Their colours and forces which mold them"* Dover, (1959). The original idea was reported in 1920.

(2) This interpretation was given by James Thomson in 1855, as Boys reported (J. Thomson, *Phil. Mag.* [4], **10**, 330-333 (1855)). The movement of liquid by its surface tension is known generally as the Marangoni effect. This may be due to an appeal of the priority by Marangoni by himself. Thomson reported his hypothesis, however, 10 years earlier than Marangoni. James Thomson is, incidentally, an elder brother of William Thomson (Kelvin). Historical background surrounding this appears in *Nature*, **187**, 186-188 (1960) by L. E. Scriven and C. B. Sternling, in detail.

(3) I wonder how this phrase appears in original Hebrew.

(4) M. Loewenthal, *Phil. Mag.* [7], **12**, 462-472 (1931)

(5) J. B. Fournier and A. M. Cazabat, *Europhys. Lett.*, **20** 517-522 (1922)

(6) Latest experiments as well as theoretical calculations are reported in, for example, the following papers; X. Fanton and A. M. Cazabat, *Langmuir*, **14**, 2554-2561 (1998); A. E. Hosoi and J. W. M. Bush, *J. Fluid Mech.*, **442**, 217-239 (2001).

(7) On http://www.yahoo.com, as of May 31, 2002.

(8) "Glycerin…" is a red herring. Putting this aside, I didn't know that Mr. Robert Parker has such a strong power that the score of a wine that he evaluates holds the value of the wine in the market. I found sharp ironic comment on Mr. Robert Parker, who gives such a typical American evaluation of wine, in *"Hugh Johnson's Pocket Wine Book 2002",* Mitchell Beazley, p.285 (2001). Let me introduce some of their interesting tips. "It seems that America and the rest of the world will never agree about the idea of scoring wines. America is seemingly besotted with the 100-point scale devised by Robert Parker based on the strange US school system in which 50=0. Arguments that taste is too various, too subtle too evanescent, too wonderful to be reduced to a pseudo-scientific set of numbers fall on deaf ears...America likes numbers (and so do salesmen) because they are simpler than words. When it comes to words America likes superlatives." After this introduction, he shows The Johnson System such as;

The minimum score is 1 sniff

One step up is 1 sip

2 sips = faint interest

A half glass = slight hesitation

1 glass = tolerance, even general approval

Two glasses means you quite like it (or there is nothing else to drink);

Three glasses – you find it more than acceptable;

Four – it tickles you fancy;

One bottle means satisfaction;

A second bottle is real thumbs up. The steps grow higher now;

A full case means you are not going to miss out on this one...and so on.

The logical top score in the Johnson System is, of course, the whole vineyard.

By the way, among the universities in Japan, numerical evaluation, such as the impact factor, or the number that one's paper was referred in others', is spreading quickly. Professors may be evaluated with 5-point score in the near future. These objects of evaluation might not attract people so much as wine does, but are of wide variety, delicate, and sensitive. What will Mr. Johnson comment if he hears that such objects be scored? I am sure Mr. Parker will proudly mutter that such a score holds those professors' value in their market.

Translated by Tomo. SAEKI 6/28/2003.