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Teachers Debate Cold Fusion

Ludwik Kowalski
Department of Mathematical Sciences
Montclair State University, Upper Montclair, NJ, 07043

What follows is a collection of messages about cold fusion from teachers. The messages were posted on the Internet discussion list, Phys-L, or were sent to me in private. **They illustrate a wide range of opinion.** PHYS-L is a list dedicated to learning and teaching physics with 700 subscribers from over 35 countries, the majority of whom are physics educators. <http://lists.nau.edu/archives/phys-l.html>.

Teacher 1

The cold fusion situation in the USA can be characterized as a conflict between a group of scientists and the government (represented by DOE and NSF). This reminds me of two other conflicts of that nature; both in the former USSR. **Soviet geneticists and Soviet cyberneticists were “excommunicated” on ideological basis rather than on the basis of scientific argumentation.** These fields, labeled as “reactionary science,” were later rehabilitated. (But many “voodoo scientists” died in prisons and concentration camps before being rescued.) To refresh my memory I went to the Internet and found <http://www.pact.sccc.ru/history/early.html>. It tells us that:

“Norbert Wiener’s book ‘Cybernetics or Control and Communication in the Animal and the Machine’ published in 1948 was actually banned in the USSR, because some ideas expressed by Wiener did not agree with official Soviet doctrine. In 1953, the leading ideological journal ‘Problems of Philosophy’ published a notorious article ‘In whose service is Cybernetics?’. The author, who hid himself under a pseudonym ‘Materialist,’ wrote: ‘The theory of Cybernetics, trying to extend the principles of modern computing machines to a broad variety of natural and social phenomena without due regard for their qualitative peculiarities, is mechanism turning into idealism. It is a **sterile flower of the tree of knowledge** resulting from a one-sided and exaggerated blowing of a particular trait of epistemology’. And further: ‘The imperialists are unable to resolve the contradictions splitting the capitalists’ world. They cannot prevent the approaching inexorable economical crisis. They try to find salvation not only in the frenzied arms drive but in the ideological weapon as well. In the depth of their despair they resort to the help of pseudo-sciences giving them some shadow of expectation to lengthen their survival.’

In the article 'Cybernetics,' in the 4th edition (1954) of 'Concise Dictionary of Philosophy' this science was defined as a **'reactionary pseudo-science which appeared in the USA after the World War II and became also wide spread in other capitalist countries; a kind of modern mechanism'**. One can easily imagine what it meant to defend and disseminate a 'reactionary pseudo-science' at those times in the Soviet Union!" Nevertheless, some scientists (described on the same web site) were brave enough to defend the field excommunicated by ideologically motivated officials. **These scientists are now honored as pioneers of new technology.**

Similarities and differences between situations in two different countries are worth thinking about. **Cold fusion will remain** an important social and historical event, regardless of scientific verdicts about its claims. **That is why the subject should be discussed with students.**

Teacher 2

The topic of cold fusion is most interesting but I'm surprised that it is still a topic of current debate on this list-server. **I recall that someone reported that cold fusion had been achieved a few years ago but no one has been able to reproduce the effect to this date. However, I thought that most scientists now agree that cold fusion can never be achieved.** Is there any new evidence to the contrary or is it like the alchemists who spent many fruitless decades trying to turn lead into gold?

Teacher 3

I think there exists **new evidence for three things:**

1) Anomalous heat is now more reproducible, and not only via electrolytic loading. It has been observed in a deuterium gas discharge tube with a palladium cathode, and in a vessel containing palladium and hot deuterium gas at high pressure. But success depends on factors which are difficult to control. These factors were not known when cold fusion was announced. (Furthermore, reproducible excess heat is often generated at low rates, typically one watt or less. It is natural to suspect that heat generated at such rates might be non-nuclear, unless a complete analysis of all chemical processes is presented.)

2) Unusual nuclear processes (transmutations, emission of nuclear particles and electromagnetic radiation) accompany generation of excess heat. This happens in electrolytic cells, in gas discharge tubes and in high pressure vessels.

3) These puzzling processes do not resemble familiar thermonuclear fusion taking place in very high temperature plasma. The ratio of tritons over neutrons, for example, is highly skewed (by many orders of magnitude) in favor of charged particles. Another dramatic difference is that the reported production of ^4He is not associated with the emission of 23.8 MeV photons; the released energy appears as heat.

Most of us are not able to verify these findings. That is why I think that **it would be desirable if a new panel of experts** (physicists, chemists and material scientists) were

created by our scientific establishment to evaluate the validity of recent findings and claims. I do not want to be like those who refused to look at what Galileo was showing because, according to Aristotle, such things were not possible.

Teacher 4:

The whole atmosphere around CF has been filled with **poisonous material**, some valid and some emotional. One must be very careful, on entry into such an atmosphere, to be protected by a useful theoretical proposal or at least a plausible explanation that can be subjected to experimental tests. **On the basic level there are two obvious questions:**(1) **How could hydrogen atoms fuse at such a low temperature?** (2) **If they do fuse, how is the energy released (if not in gamma rays, then how) i.e. what reaction occurred?**

If one has no proposed answer or proposed experiment to get an answer, then one is **in a state of massive weakness**. Your message seems to be that there is new evidence for an interesting mystery, and the early workers were not fairly treated. **The author of such a message will be classified as an apologist or defender, no matter how he qualifies such words**. If, however, he has a plausible proposal, it could possibly be different. I infer that the major skepticism in the mainstream nuclear science community stems from the silence on the basic two questions above. **Such skepticism seems to me to be justified until something reasonable is proposed or, better yet, demonstrated. Until then, essentially all responses will be "impurities or errors".**

Teacher 5:

First of all, just because someone says 'a new result is only accepted if there is at least a plausibility argument advanced to support it' doesn't make it so. **You don't have to look any further back than the announcement of high-Tc superconductors to see that such is not the case. When the announcement was made, no one had any theoretical explanation for how it could happen.** The BCS theory only applies in metals with free electrons that can be paired up, not in ceramic insulators. But the claim was made that these ceramics could be made superconducting at much higher temperature than the highest known metallic superconductor. What was the reaction of the physics community? Not to say, 'Oh that doesn't fit our neat BCS theory, so it must be wrong.' No, it wasn't that at all. Large numbers of groups rushed to their labs to try it out to see for themselves if it worked. And, lo and behold, it did work! To this day, as far as I know, there is no satisfactory explanation of the effect.

Teacher 6

When **challenging the "laws" of physics** there's a right way and a wrong way to go about it. (The same applies to any other activity.)

A1) The rules need changing, and the scientific community handles it well.

A2) The rules don't need changing, and it is handled well.

Example: The null results of Eötvös.

- B1) The rules need changing, and it is handled poorly.
B2) The rules don't need changing, and it is handled poorly.
Examples: N-rays, cold fusion.

And there is a fifth class, where the scientific community responds scientifically but fails to bring the broader society along. Examples: copper bracelet therapy, magnetic bracelet therapy, homeopathic medicines. The task of challenging established ideas is not assigned only to giants like Michelson and Rumford and Rutherford, but also to every worker-bee in the scientific community. To summarize:

- Primarily we should discuss the right way to challenge the established rules. And the necessity for doing so.
- Secondly we should discuss N-rays, cold fusion, homeopathy, etc. as counterexamples, as perversions. We shouldn't call them "positive".

Teacher 7

The skepticism about "cold fusion" arises not because of any "conspiracy" on the part of "orthodox" science, but rather because literally **hundreds of competent scientists have attempted to reproduce the effect without success**. The nuclear reactions associated with fusion are well understood, and have well known signatures (reaction products such as neutrons and gamma rays). These have been looked for with the most sensitive of detectors, and have not been found. Since fusion is a nuclear process, it is these nuclear reaction products that carry away the excess energy. **If you don't have any nuclear reaction products, then it can't be a fusion reaction that is taking place in these "cold fusion" cells.** Rather than taking someone's word for it (even if that someone happens to be Clarke or Schwinger), I prefer to base my own judgments about "cold fusion" on the evidence. **And right now the evidence for "cold fusion" is pretty meager, while the evidence against it is pretty strong**, at least IMHO.

Teacher 8

I believe that it is nigh-impossible to change people's opinions regarding "Cold Fusion," so I usually am not tempted to dive in and argue about it. When any reversal of opinion requires the losing of face, then reversals of opinion cannot occur in public. Therefore why even try? **If "CF" is eventually shown to be valid, then everyone will leap on the bandwagon, but there will be no detailed investigations of the ones who spent years ridiculing the topic. "Who, me? I was always a supporter!"** It sure is easy to be on the side that's winning. I hope that I myself, years from now when CF is shown to be entirely bogus, will still have the stomach to read all these old archive files and see what led me into my shameful pro-CF beliefs. I probably won't though. I'm just as human as anyone.

The CF effects seem to be critically dependent on microscopic surface processes which nobody understands well. If it was easy, we wouldn't be having this discussion, and "CF" would have been immediately industrialized. That it was not, is evidence either that it doesn't exist, or that it always was a feeble, flaky, poorly-understood effect. In

addition, if it is an effect which attracts the wrath of those who dislike the idea that theory-violating anomalies exist, then it is little wonder that the CF field is just where it is today. "Extraordinary phenomena require extraordinary evidence." In other words, we raise the bar for results which go against theoretical expectations, and lower the bar for results which validate known theory.

Teacher 9

Let me share **an interesting observation** made by a biochemist, in a private conversation. "Trying to publish something in a scientific journal means convincing the editor, and reviewers, that the expressed ideas fit the existing paradigm. That is why those who discover unexpected things often encounter difficulties in trying to publish articles. **But trying to patent an invention is just the opposite.** The patent bureau wants ideas which are really new; something that is already known is not acceptable."

Teacher 10

I enter this discussion **with great fear**, but I can't help getting this out of my system.

(1) Can we agree that there can be a small amount of **muon induced fusion** in a tabletop experiment, but not enough to make significant temperature changes?

(2) Can we agree that the other types of cold fusion that are being discussed **require us to violate Coulomb's Law and therefore are unlikely to occur?**

Teacher 11

>If the CF phenomenon is genuine, then it means that the staggering amounts
>of **money put into Tokamak-style fusion might have been wasted.** It means
>that hundreds of people devoted their careers to a technology which might
>prove of little worth should electrochemical-fusion result in efficient
>reactors. Obviously the pressures on such people would be tremendous.
>They would have to be literal *saints* to not be affected by it. If they
>are normal, non-saintly humans, then they would be in danger of succumbing
>to tricks of their subconscious, such as conveniently finding strange
>justification and weak excuses **to dismiss CF as unreal**, and they would not
>even know that they were doing this. It would seem perfectly sensible at
>the time, yet future historians would see something entirely different.

And likewise for the CF proponents. What they lack in time and money expended they make up for with pride and the desire to retain professional respect in a field marred almost from the get-go. **The earliest proponents of CF were the worst of all possible foxes in charge of the chicken coop.** Everyone since has labored under this cloud and they are mostly in the unenviable position of "put up or shut up," a virtual death sentence of many things science in today's research atmosphere.

Teacher 12

In my reading of CF literature, I've not encountered any "conspiracy theory" stuff. In the "perpetual motion" and "antigravity" crackpot fields the situation is far different. There it's rare to find a researcher who DOESN'T accuse government or industry (or Space Aliens!) of suppressing the research. When the crackpots start discussing antigravity, it's an effective (though dishonest) tactic to bring up conspiracies. The crackpots will launch into paranoid tirades and destroy their own credibility. But try the same with Cold Fusion people, and it is not *their* credibility which comes into question. Cold Fusion requires serious brainpower and facilities before any research can be done. Cold Fusion supporters are professional physicists and engineers, not weak-minded inventors who, once disparaged, will STAY disparaged.

Teacher 13

With the possible exception of the two that put it on the map: While Pons' "partner in crime" has perhaps gotten some unfair coverage, Pons himself was the original apparently-respected researcher who could not sort out conflict of interest, who could not stand the thought of being corrected (much less being wrong) and who could not stand up to the political machine that took over. Had CF followed the path set out by Jones, it would not be where it is today. It seems that an original approach of slow methodical unheralded peer-reviewed research would have been better for the entire CF field.

Teacher 14

Look at the titles of these recent books; they are revealing.

- 1) C. Beaudette, "Excess Heat. Why Cold Fusion Research Prevailed." Concord, NH, 2000.
- 2) R.L. Park "Voodoo Science: The Road from Foolishness to Fraud," Oxford University Press, New York, 2000.

One reviewer wrote: "Professor Park does more than debunk, he crucifies... You'll never again waste time or your money on astrologers, quantum healers, homeopaths, spoon benders, perpetual motion merchants, or alien-abduction fantasists."

But isn't "cold fusion" different from the above? I do not exclude the possibility that some "cold fusion" claims may have been fraudulent; con artists are naturally attracted to scientific controversies. But most of those who do research in the area are likely to be honest. In fact, I suspect that Fleischmann and Pons might become Nobel laureates.

What makes the AE area different from voodoo science?

- 1) A large number (several hundred) of cooperating scientists in about 10 countries are actively involved.
- 2) Two Nobel laureates (Teller and Schwinger) were theorizing about AE at one time. Have they given up? I do not know.

- 3) Nearly all of the AE researchers have doctorates; many of them are (or were) associated with highly prestigious laboratories and universities. Many of them, including Fleischmann, are (or were) recognized leaders of disciplines.
- 4) These researchers organize one international conference each year and make results of their findings known to all who are interested.
- 5) Their methodology of validation is not different from that practiced by so-called "mainstream" scientists. They experiment, they hypothesize, they change their minds, they try to construct theories, they publish.
- 6) They are not secretive; they want to be heard and be criticized scientifically.
- 7) They want to have access (as authors) to all mainstream journals in order to benefit from the peer-review process.
- 8) They want their proposals to be fairly evaluated by NSF, DOE and other granting agencies.
- 9) They are highly unhappy about the "blacklisting" of the entire field caused by tactical mistakes made by those who prematurely announced the discovery in 1989.

Is it not obvious that claims made by “astrologers, quantum healers, homeopaths, spoon benders, perpetual motion merchants, or alien-abduction fantasists” are completely different from those made by AE scientists?

Teacher 15

It would be nice if we could rush to labs to perform described experiments by ourselves. This is not practical, we are not experts and **many experiments are just too complex and too costly**. Very few, for example, can repeat an experiment in which reality of quarks was confirmed. **Most of us simply believe in what has been pronounced to be true by experts**. This, of course, does not apply to simple experiments, such as those performed by students in our laboratories. One of the mistakes of Fleischmann and Pons was to say that cold fusion experiments are very simple. History would probably be very different if they waited longer before releasing an important announcement.

Teacher 16

In science it's wrong to first adopt a viewpoint and then to use the selection of evidence in order to support that viewpoint. **Politicians do it. The legal system is based on it. Science is totally different:** a bend-over-backwards search for the truth rather than a defense of a an existing position during a debate. If one claims to be scientific, yet also adopts a position not based on evidence, then that is pseudoscience.

Teacher 17

I am following your exploration of the CF phenomena with great interest; I am hoping there may be something in it after all. I am especially interested in the Karabut type experiment. However, I think your comments on the Ohmori-Naudin experiments need additions from the constructive sceptics, for example the results of Little at EarthTech < <http://www.earthtech.org/experiments/index.html> >. They have seen no excess heat, and they are in close collaboration with Ohmori.

Teacher 18

What might skeptics say about recent cold fusion data?

1) Muzino and others in Japan are liars, like Karabut and others in Russia, like Bressani and others in Italy, like Lonchamp and others in France, like Bockris and others in the US. **The data are fraudulent.**

2) These people only pretend to be scientists. Their Ph.D. diplomas were counterfeit; their professorships at famous universities were bought; the books and hundreds of articles they published were produced by somebody else. They are members of an **international "mutual support society."**

3) **We already know everything** about nuclear phenomena; facts which disagree with existing theories are not acceptable. Absence of commensurate amounts of neutrons and protons is a sufficient reason to ignore claims about unusual nuclear processes.

4) Cold fusion researchers were often wrong in 1989. Therefore what they are finding now must also be wrong. **They should never be forgiven** for announcing a discovery via a press release, or for claiming that excess heat experiments are very simple.

5) Claims made under the banner of cold fusion were not described in articles published in leading journals. Therefore they **cannot be accepted**. **The editors of these journals refuse to publish cold fusion articles; they know better what is right and what is wrong.**

6) Neither the Department of Energy nor the National Science Foundation supports research in the area of cold fusion. Therefore such research is **not worth taking seriously**. **Those who perform experiments cannot be objective about their own research.**

7) Practical applications of cold fusion have not been demonstrated; therefore the underlying phenomena **cannot be real**.

8) We know nothing about recent cold fusion findings; **therefore they must not be correct**. **The entire field was declared pseudoscientific in 1989 by a panel of experts. The opinion of experts must be respected; it can not be challenged by new findings.**

9) Experiments **should be 100% reproducible** before they can be accepted.

I agree with the last reservation. Lack of reproducibility is a clear indication that some important parameters are still not under control by experimentalists, and that conclusions are tentative. **Electrostatic experiments used to be called “irreproducible” before the effect of humidity was recognized.** I do not think that it is appropriate to **identify “irreproducibility” with “not being real;”** Irreproducibility is typical in all areas of emerging science. I see nothing unusual when a competent cold fusion scientist is successful only eight or nine times out of ten to demonstrate a new phenomenon. As far as I know, this is typical in only some types of cold fusion experiments. The situation is no longer as bad as it was in 1989.

That is why I think that the time is right for **a new investigation** of the entire cold fusion field **by a panel of experts**. They should focus on experiments which are nearly always reproducible, not on observations which were reported only once or twice.

Teacher 19

The situation is without precedent. Highly qualified Japanese scientists, Mizuno et al., published an article describing experiments in which generation of excess heat was said to be highly reproducible. Mizuno's findings were confirmed by at least five other teams. But no excess heat was found in several ETI experiments in Texas, as reported at: <http://www.earthtech.org/experiments/index.html>

At one point the ETI team sent their cathode to Mizuno and in his laboratory this cathode produced excess heat. The same cathode, however, did not produce excess heat in Texas. Likewise, Mizuno's cathode worked in Japan but not in Texas. And this happened despite the fact that scientists cooperated to make the experiments as identical as possible. How can this be explained? They are performing essentially the same experiment. **What should one think about a situation in which six groups are able to demonstrate excess heat and one is not able to demonstrate it?** E. Storms would say that NAE, the unrecognized “nuclear active environment,” is absent in the ETI setup. Why is cold fusion unique in that respect? Experiments are usually reproducible, more or less, in other areas of science.

Suppose the situation were different, one team claiming excess heat and six not able to confirm it. In that case most physicists would conclude that the claim is not valid. But an extraordinary claim calls for extraordinary demonstration and 100% reproducibility is expected. I suppose this is fair, provided only honest, and highly competent, teams are allowed to be involved. To read more about this go to item #50 at my website < <http://blake.montclair.edu/~kowalski/cf/> >

Teacher 20:

The cold fusion area is not voodoo science. But the phenomenon of pseudoscience is very real and **society should be protected from those who exploit ignorance in order to benefit from unscientific claims.** Selling healing bracelets is one example of this; the therapeutic effect of such gadgets, as far as I know, has not been validated. How can

society be protected from con artists without confusing charlatans with honest scientists addressing non-conventional topics? This is a difficult issue.

To protect reputation of their field cold fusion researchers should be as active in exposing pseudoscience as those who do this under the banner of mainstream science.

How active have they been in doing this? Or how often do cold fusion researchers criticize each other? My guess is that this does not happen too often. I noticed, for example, that journals like Infinite Energy, where cold fusion papers are published, also publishes papers devoted to topics of more questionable validity, such as perpetual motion devices, antigravity or hydrinos. Many cold fusion researchers probably disagree with such articles. But how often do they express this openly?

Teacher 21:

It's not hard to destroy your career as a scientist. Simply take UFO sightings/evidence seriously and devote major time to investigating them. Or dedicate yourself to researching parapsychology. Pick any one of a number of "taboo" subjects such as Cold Fusion to study, and the greater scientific community will excommunicate you by closing off funding and the channels for publication. Since CF is "obviously" a waste of time, then anyone who wants to study it must be stopped, and anyone who wants to publish papers about it must not be allowed to take up the space needed by "legitimate" papers in journals. **Censorship and intellectual suppression is perfectly sensible**, you see! Just assume that the majority opinion is always correct, do not question it, and let the "always correct" majority silence the "always wrong" minority.

[The quotations below, and many more, can be found in "Zen and the Art of Debunkery" by Daniel Drasin < <http://members.aol.com/ddrasin/zen.html> >]

1) Portray science **not as an open-ended process of discovery but** as a holy war against unruly hordes of quackery- worshipping infidels. Since in war the ends justify the means, you may fudge, stretch or violate the scientific method, or even omit it entirely, in the name of defending the scientific method.

2) **Avoid examining the actual evidence. This allows you to say with impunity, "I have seen absolutely no evidence to support such ridiculous claims!"** (Note that this technique has withstood the test of time, and dates back at least to the age of Galileo.

3) Practice **debunkery-by-association**. Lump together all phenomena popularly deemed paranormal and suggest that their proponents and researchers speak with a single voice.

4) Similarly, reinforce the popular fiction that **our scientific knowledge is complete and finished**. Do this by asserting that "if such-and-such were true, we would already know about it!"