Chapter II. The "petty" science of amateurs and underdogs/misfits

Catt's Challenge

Translation from German to English

In June 1993 a provoking notice by Ivor Catt appeared in *Electronics World* and *Wireless World* headed "The Catt's Challenge". There was to read:

" It needed a new initiative to get out of stagnation in which it is today electromagnetism. I'm probably the most famous person who works in the field, but none of the competent never will admit that he had heard or read something of my theories, I will want to expose themselves to commentaries unfavourably. In particular, no one will admit that he had heard of '' anomaly Catt, "which I made in 1987, and on which the bottom of my arguments. Consequently it cannot even be raised whether the textbooks and university degree courses should be changed or not. For this reason I decided to institute a fund for the defence of the classical theory of electromagnetism in order to remove an obstacle and standing now for over a decade. In this fund I intended hundred pounds. It will be awarded to three scholars experts electromagnetism if, and when, will take part in a meeting during which will have to defend the classical electromagnetism against the anomaly of Catt. The conference will be recorded and each participant will have a copy of the tape. They will be paid both, in case the defence is successful as well it is a failure. Whereas the critics of the classical electromagnetism do not receive money. Before the meeting reliable institutions as the Institute for Electronic and the Institute for Physics will authorise and witness the three experts that they are able to defend adequately the Classical Theory. If, as I suppose, nobody can be found who can defend Classical Theory against the theory of Catt's Anomaly the funds capital is increasing year by year. At last the Classic Electrodynamics will surrender and be sent off to the position it deserves – that means it will be binned together with all noisy ghosts and bullshit."

Tone and content of this offer could seduce to add it without further ado to the quaint (albeit sometimes inspiringly) products of scatterbrains who are bustling on the periphery of science. However, the signer, Ivor Catt, would to be classified as *crank* only with great effort, although he is an original and eccentric character. Catt, today 60 years old, is an electrical engineer technician with a through and through fair professional career: In 1959 he made his degree in Cambridge and after that designed hardware for some of the biggest computer manufacturers of Great Britain and the United States. In 1972 he had his "Catt's Spiral" patented, an engineering process for the fabrication of a groundbreaking chip, which initiated the era of the so called "wafer stacks integration" (WSI). The first produce of new technique (the wafer stacks or semiconductor chips/ flip chips) were manufactured by the Anglo-Japanese joint venture of the companies Anamartic, owned by Sir Clive Sinclair and Fujitsu, who bought and commercialised Catt's patent.

The man who wants to revolutionise electromagnetism not only can pass as qualified and competent engineer but also as an original and creative mind, who contrived a substantial improvement in computer technology.
Furthermore the trials and tribulation history of the "Catt's Spiral", deliberately disregarded by the industry of computing for a long time, seems to recommend not rashly give away the scientific reliability of "Catt's Anomaly". That is to say, for 25 years the biggest computer manufacturer refused to consider Catt's proposition and no relevant professional journal on this subject ever wanted to accept an article about this special field. In the nineteen seventies "Catt's Spiral" was a heretical idea as it is today "Catt's Anomaly".

Until July 1983 when Sinclair decided to invest in Ivor Catt's proposal, Catt commonly was considered as a classical *crank,* some kind of bogeyman of the international computer community. Not only because of his unconventional opinions but also because his hypothesis was picked up in the nineteen sixties by "Big Blue" (IBM) and was discarded as too expensive and technically too laborious. To say it in a nutshell - a way not being worthwhile. For that a certain evidence existed. Halfway through the nineteen seventies namely Gene Amdahl, one of the most distinguished and ablest designers in hardware at IBM attempts to go the way of integrated semiconductor chips, had quitted Big Blue and established his own company *Trilogy*. That succeeded to receive 240 Million Dollars from Sperry, Digital and from the French company Bull to build the new chip-type. Finally in June 1984 Amdahl had to admit, to the obvious great pleasure of IBM, that is was not possible to bring the project to a good end. Hence in 1983 there were good reasons to consider the project as forlorn when Sinclair and Catt agreed to work in the same direction. Actually one was convinced that integration on the level of semiconductor chips can be used commercially if and only if one could produce semiconductors without faults. Evaluated by Amdahl this the soonest will be achieved in 100 years. Amdahl was this pessimistic because he couldn't solve the main problem of the wafer stacks-integration. Usually the chips are built upon the base of a silica semiconductor disc (wafer) of about 12 to 13 cm in diameter. Because normally these wafers contain not to work properly parts they were split into hundreds of little chips to separate the good ones from the useless. Then the properly functioning chips are mounted on a substrate with lithographed solid-state circuits, connecting each other. A procedure like this turned out difficult and costly but Amdahl couldn't find a more economic or quicker production process. Compared to Catt who succeeded in doing this. In his ideated system he introduced software which is testing the silica disc, connecting the functioning parts among themselves and discloses the useless parts automatically without fracturing and removing them. At the beginning one of the possible basic entrance to the semi conductor disc is chosen and the first chip of the sequence is tested: Under principle of contingency it is loaded with data and classified okay if the tester gets back a correct signal/message. As a second step the tester is instructing the working chip to make contact to one of the four neighbouring chips. Then data are provided (consequently always via the first functioning chip) until one gets an appropriate check back signal with which the proper functioning of the second chip is confirmed and so on. At the end you get a "Chip Coil" of correctly working chips residing in a sequence order on a little semi conductor disc. This disc can contain a considerable amount of not working segments but excluded from the connection. Thereby the necessity to mount the chips on a chip substrate is obsolete. The substantial advantages are to be found in the increased memory/storage capacity (the 1989 on the International Solid State Circuits Conference in New York presented prototype had a storage capacity of 200 billion bites in a single round semiconductor disc of about 13 cm) and in the easy integration capability into the architecture of the computers. The working semi conductor discs are connected among one another with the same mechanism their proper functioning is proved and it is not necessary any longer that each of it has an independent interface. Thus the connections are substantially simplified. As often experienced in retrospect view the solution is obvious easy at hand At the end of the nineteen sixties none of the multinational consolidated companies would have invested a dime into Catt's proposal. Nobody
took him serious: All companies he signed on discharged him the sooner or later. During the six years he spent in America (USA), 1962 to 1968, Catt worked for 5 companies in three different states. His experience with the American industry turned out traumatically. It seemed to him to have blundered into a dangerous madhouse: big business rivalry, enviousness, punches below the belt right after a friendly slap on the back, crazy careers. allowed a rise in salary today and a dismissal tomorrow: projects for billions, started with great hopes and abandoned after a few month, dismissals permanently, stress up to the limits of endurability and all in a strange mixture of ingeniousness, brilliancy and superficiality. After this experience Catt was not the same any longer and in 1971 he

decided to impart these experiences in a little but keen book. *The Catt Concept*, a recommendable reading not only for the managers of multinational computer companies but for all who are interested in the subject.
According to Catt the way of the American technology, spreading worldwide, consists of a "New Industry Darwinism", of the law of jungle with few but simple rules saving the individual viability but inhibits progress in technology and eliminates persons psychologically.
In conformity with Catt the predomination of this logic turns live of computer scientists into a constant rat race and transforms it into a hell but also slows down the progress in information technology (IT) and is misleading it. After having patented his spiral in 1972 he resorted from computer science world and taught engineering technology at the Polytechnic of Hatfield. 1983 he answered to an advertisement posted in the Observer by the company of Sir Sinclair and finally got the chance to realise his project. In the meantime changes in his private life happened and have not failed to leave their marks on him: His wife Freda, tired from a live of constant fights and permanent insecurity, filed a petition for divorce, also because Cat's bipolar character became more obvious.
Additionally he discovered the "Catt's Anomaly" and conceived the idea to underpin electromagnetism entirely new. But - in what consists this "Anomaly", and why should it revolutionise the textbook knowledge of electromagnetism? Catt himself explains the core of his finding as follows:

"Let us consider the increase the tension/voltage of an electromagnetic transverse wave, propagating from left to right through two perfect conductors. Before Variation of the potential the induction lines end, coming from the upper (positive) conductor, in the bottom conductor in electrons (n x cm of the length of the conductor). These electrons joins to the electrons (m x cm), which are neutralising the holes in the molecules of the bottom conductor. Whereas after the differentiation m electrons x cm of the length of the bottom are available, neutralising the holes too. During the following 30st part of a ns the increase of the tension is propagating about 1 cm. So n new electrons are appearing in the same section of the bottom conductor to shut down the new tubes of flowing induction between the two conductors. Where does these electrons come? Not from the upper conductor, because the flow of induction current per definition not consists of a flow of electrons. Somehow or other they also not can come from left, that means, from behind the voltage step, because these electrons travel with speed of light in vacuum. Classical electromagnetic theory asserts:a) that that an electromagnetic transverse wave, guided by two perfect conductors is travelling without any variation with speed of light in vaccum. b) that the electric current lines end in electric charge c) that the electric charge is travelling with a clear lower speed through the conductor as speed of light in vacuum. Consequently the classical electromagnetism is dead."

The essence of Catt's assertion that the actually used concept has to be abandoned/given up because it is self-contradictory and furthermore it forbids progress in development of knowledge in the field of electromagnetism. Instead of paying particular attention/interest in the wires on which the electric current is driving along one have to pay attention to what is taking place/occurs outside of the conductor. If there is a field around the wire just it is believed today because of the process in the conductor. Whereas a lot of signs indicate to the concept/view of Oliver Heaviside, according to which the current in the wire is produced/caused by the energy which is transmitted in the space around the wire, named "Current Power" by Heaviside. The evidence for that would be the anomaly Catt discovered. Should it be proved true indeed the theory of electromagnetism must be formulated entirely new.
Up to now the science community obviously is not sharing Catt's opinion that such a revolution is necessary. Even though by common consent it is believed that this anomaly actually is existing but it can be explained like the most of anomalies without establishing electromagnetism entirely

new/from scratch. One possible explanation comes from Professor Pepper of the reputable Cavendish Laboratory in Cambridge. In June 1993 Pepper wrote to Catt:

"If I understand the position correctly, your question concerns the source of the charge at a metal surface which by responding to the presence of the EM wave ensures that the reflectivity of the metal surface is virtually unity, hence providing waveguide action and related applications. If I may restate the basis of your question, what is the maximum frequency of radiation which is reflected? It is this parameter rather than light velocity which is important. The solution lies in the maximum frequency response of the electron gas, which is the plasmon frequency w p and is calculated in a straightforward way. If light frequency is greater than w p then the electron gas in the metal can no longer respond and the reflectivity tends to zero. The problem you are posing is that if the wave is guided by the metal then this implies that the charge resides on the metal surface. As the wave travels at light velocity, then charge supplied from outside the system would have to travel at light velocity as well, which is clearly impossible.
The answer is found by considering the nature of conduction in metals. Here we have a lattice of positively charged atoms surrounded by a sea of free electrons which can move in response to an electric field. This response can be very rapid and results in a polarisation of charge at the surface and through the metal. At frequencies greater than w p the electron gas cannot respond which is the reason for the transparency of metals to ultra-violet radiation. However for frequencies used in communications the electron gas can easily respond to the radiation and reflectivity is unity.
If a poor conductor is used instead of a metal, i.e. there are no freely conducting electrons, then there is no polarisation, and as you point out charge cannot enter the system, and there can be no surface field. Consequently reflection of the radiation will not occur at these low frequencies and there is no waveguide action. I hope that these comments provide a satisfactory explanation. Yours sincerely, [signed] M Pepper"

In a not posted letter but he let circulate it among his friends Catt takes the view that the suggested explanation doesn't take effect rather verifies Pepper's total incompetence. In Catt's opinion Pepper is an expert in semiconductor and physics of solids but both has nothing to do with his problem as "there is an abyss between the theory of semiconductor and the theory of electromagnetic, caused by the electromagnetic transversal waves."
Any textbook about electromagnetism, Catt is protesting, contains a chapter about semiconductor or vice versa textbooks about semiconductor doesn't show any remarks about electromagnetism". On a technical scale, Catt states, Pepper's solution is obtained by denying the Theorems of Gauß, the basis of one of the fundamental equations of Maxwell despite the fact that he is postulating "a sea/ocean of free electrons without their electric field" which are waiting for the arrival of the electromagnetic transversal wave. "Pepper", so Catt polemically, "should take a perusal of the fundamental textbooks of physics. In the meantime he would do good to stay out of the discussion."
It is difficult to decide whether Catt is right or not but history is telling us that we should bow an ear to heretics (even they sometimes become polemic or uncomfortable/unpleasant) . Far too often science was forced to intone a "mea culpa" because of disdaining and quickly brushing aside researchers but/and later had to acknowledge their ideas as correct.