PHYSICS AND PHILOSOPHY

by

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The progress of scientific knowledge

Has scientific knowledge a certain direction? What are the goals of the scientists with science?

It seems as a best way to start inquiries about these questions if a concrete example is shown. E.G. Stahl (1660-1734) German physician thought that there existed an essential difference between the living and the lifeless coming from a special matter leaving the body in death. (Theory of vitalism.) While he applied his idea in medicine, the notion about the existence of special matters he extended upon the fire as well. Fire is thus a discharge of a matter, phlogiston, as he mamed it, from the burning object. He proved this thesis by measurements experimentally. Copper has been burnt and its weight increased by burning. Stahl explained the result by the exit of phlogiston which had a negative weight accordingly.

Many a scientists accepted Stahl's theory about fire, and tried to generate phlogiston to no effect. However, the English J. Priestley (1733-1804) by burning mercurioxid got a gas which he took dephlogistined air as in his gas everything was burning far better than in the air. Priestley thought that deprivation of the air from phlogiston brought about a thirst fo it. He also discovered that a mouse held in his gas under a bell remained alive longer than an other one held under a bell filled with common air.

The French A.L. Lavoisier (1734-94) heard about Priestley's findings and took up the thread of the inquiries. Priestley's gas was by his opinion a part of the air, oxygen. Fire is the entry of oxygen in the object and not the exit of phlogiston. Oxygens has a positive weight increasing that of the matter by burning.

So, Lavoisier changed Stahl's theory about fire in such a way that there exists a special matter, an "element" entering into the object instead leaving it. Lavoisier also extended this idea postulating the existence of more different elements. He thought that elements differ from one another by their weights which remain unchanged in different matters. By this idea Lavoisier established the modern chemistry. However, the development of science at this direction destroyed the original idea about the essential difference between the living and the lifeless. Science thus returned to that point from where Stahl got off, showing that his original concept was false, but its extension to fire proved to be a productive error.

What else is to be learned of this example yet? It is noteworthy that new ideas are always extended in a sense of a ruling system upon a broader territory of phenomena. Such inferences are not accepted without justification made, if possible, by experiments serving data of measurement. Influence of reality is thus strengthened as a control by quantitative results at least in physics, of which this is its basic characteristic. Progress of science is going on by repeated reformulation of the initial ideas not by arguments alone but by correction of errors with reference to collected data. Science is thus a knowledge of reality in a positivistic sense approaching it endlessly starting again and again with new concepts to be reformulated repeatedly.

Lavoisier in the above story took Priestley's mice put under the bell into consideration too. He supposed that it was the same process caused by oxygen during fire which followed in animal organism inhalation of air. This distinction of a

quick and slow type of fire revolutionized the idea of this phenomenon and was at the same time instrumental in discovery of metabolism in living organism as well.

Scientific knowledge is, then, often developing by the change of ideas. This fact alone shows that the previous ideas were at least partly false and necessarily the new ones must not be absolutely true. This does not mean that reality is unknowable, but ideas, prerequisite to knowledge, are in some degree always erroneous. However, without an idea unifying certain details the observer is blind for the manifested facts. The importance of this side of discovery has been pointed at by Darwin. He in his Autobiography[1] related about his tour of study made as a student of university together with his professor of geology the followings. "On this tour I had a striking instance how easy it is to overlook phenomena, however conspicuous, before they have been observed by anyone. We spent many hours in Cwm Idwal, examining all the rocks, with extreme care, as Sedgwick was anxious to find fossils in them; but neither of us saw a trace of the glacial phenomena all around us; we did not notice the plainly scored rocks, the perched boulders, the lateral and terminal moraines. Yet these phenomena are so conspicuous that, as I declared in a paper published many years afterwards in the Philosophical Magazine, a house burnt down by fire did not tell its story more plainly than did this valley." In the time of this tour, of course, glaciology was unknown yet.

However, what is the source of which the wish to obtain scientific knowledge springs? What is driving the scientist to

seek methods by which the influence of reality upon ideas can be enhanced? How they find new ideas affecting one another from the distance in space and time?

These questions should and could be inspected only in a roundabout way. Therefore at first the development of personality will be mentioned shortly.

Co-operative educational inter-relationship

What is development of personality and how is it going on? To avoid generalities the most conspicuous and the best understandable example of the development of personality is selected, that of the baby.

A newborn baby is without all self-sufficiency. Notwithstanding this there are going on in its organism very sophisticated regulations (regarding the circulation of the blood, the ventillation, the thermoregulation etc.). But a number of problems arise again and again which need for their solution assistance of the mother. The helpless state of the baby is though changing rather quickly. A baby of some months of age is already helping to hold the drinking glass. Some months later it is holding it alone and drinks without assistance. In a time the thirsty child takes the drinking glass and goes to the faucet for water. Development of its personality appears in the rise of the level of self-sufficiency. It is a common opinion in our age that the development described is a spontaneous one, inherited maturation. Hence a detailed inspection of the process is suggested.

At the moment a problem is arising for the baby. It needs assistance to cope with. It is going to cry. This moblizes the mother as she is willing to help which is of great importance

and not at all self-evident. For help's sake she must understand what her child's problem is and how to solve it, from where her competence arise? She is directed by the behavior of the baby. Even a newborn baby can by this way clearly direct its mother. However, her co-operation is not confined to the solution of the given problem, but she is inducing her baby to co-operate with her as well. The infant is also disposed to help as seen. The mother is never quite content with her baby's co-operation improving it by any means. No details of all these will become conscious for the mother save a general feeling abouth the growth of the aid by her child. This is the result of the spontaneous education of the baby by the mother complementing her cooperation. The adequacy of this education is effected by the learning of those directions which the mother gets from her baby in their co-operation. So, the mother is educating her baby who is educating her for better co-operation. Thus, the mother is going more and more skillful in dealing with her baby. And the baby?

As the child is learning co-operation with its mother helping to solve the baby's problems, as better its co-operation with its mother is, so greater is its contribution to the solution of the problem by the mother. At last the child will cope with the problem alone, becoming from this aspect self-sufficient. So, the child learns co-operation in order to become i n d e p e n d e n t . At first the mother should accept the child's problem as her own one to be transformed subsequently into a problem solved by the child itself.

Development of the child's personality is not restricted

to the independent solution of more and more concrete problems, but it includes the ~~general~~ growth of the general ability for cooperation as well. This is requisite to teach its mother for the skill to find the necessary conditions to overcome obstacles arising in cooperations of increasing sophistication. The mother learns from her baby how to create those conditions which are to its development of personality essential. Thus her own ability for cooperation is increasing as well which is a part of the development of her personality. So, both the mother and her child participate in the development of personality of one another mutually bringing about the c o o p e r a t i v e e d u c a t i o n a l i n t e r - r e l a t i o n s h i p .

The above concrete example is of a general relevancy to the development of personality always realizing in cooperative educational inter-relationships (even for autodidactic subjects).

Now we must speak about an important part of the above example neglected for the time being. The development of the personality of the child contains its learning to speak as well. It is also learned by the unintentional teaching of its mother in the following way.

The mother is always speaking to her child since its birth whenever she is dealing with the baby. She relates what problem the baby has ("what is the trouble?"), what it feels ("you are thirsty, this makes you crying") and what is her intention and so on. In a time as a part of its co-operation the baby learns that what is held, is a "glass" and it "is held" by its "hands" and it is "drinking" and is "thirsty" and later "is not". Learning is attained as simultaneous

occurrence of natural and verbal stimuli (input) are connected with the subsequent response (output) making thus a complex system in brain's activity.

The mother sees that her speaking has a calming effect on the baby conjecturing at the same time from the change of its behavior that the baby makes out the sense of her words better and better. Her highest goal at each occasion is to advance their cooperation in everything. In so doing she makes use of the babbling of her baby too. She tries to understand its meaning exerting thus an influence upon the active "speaking" of the child by selection (and imitation) of its "comprehended" voices. Consequently the baby gradually begins to speak which at first is alone apprehended by the mother. The active speech of the child is also improving the necessary cooperations.

The mother in her teaching her baby to speak is using the words and expressions of the language of her community. Yet the idea e.g. of a drinking glass is not the same for her and her baby of course. The meaning of words appears for the child during common activity with its mother as a part of the cooperative educational inter-relationship. A cooperative heuristics is going on thus making an important side of the development of personality following for the whole life. Let be mentioned here that the mother aims in teaching her baby to speak to promote their cooperation. However, she thus increases the ability of her child to cooperate with other members of the language community as well.

But surely there arose the following question. How to verify the existence of cooperative educational interrelationship phenomenon and what supports its importance in development of personality ascribed to?

Ortofunctional and dysfunctional personality

It follows of the above statements that in lack of cooperative educational inter-relationship development of personality of the baby is arrested. Is it so and if so, what are its consequences?

Who would dare do experiments upon children to answer these questions? Alas, there is no need of experiments as one baby of five hundred ones is born as handicapped for cooperative educational inter-relationship. In some months of age they are diagnosed by doctors as cerebral palsy cases. Crebral palsy is described in medicine as a disease causing movement disorder, palsy and involuntary movements. However, its essence is the arrest of development of personality and it leads to apathy. The symptoms mostly discoverable at the first days of life are seen as obstacles thrown in the way to create cooperative educational inter-relationship. The later symptoms based on the initial ones are rather the consequences of the cessation of development of personality of the child. The cerebral palsy cases in our age and in the developed countries are cared for in beautyful institutes under the treatment of a team of specialists. They have admirable rolling stools furnished

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with all possible inventions. Nevertheless they sit fastened by straps lest to drop, can not handle the remote control of TV, they are for long years sitting or lying apathetically.

However, the mothers of these babys can be instructed rather simply how to put up cooperative educational inter-relationship with the child in spite of the handicap. At first the child's apathy stops in some days. The mother by an hour instruction in two-three weeks can restore cooperative educational inter-relationship with her baby attaining thus fully orthofunctional development of its personality. All the symptoms of cerebral palsy of the child disappear in one-two years and the child is going physically and mentally sane. (Even ~~greater~~ older children of cerebral palsy may be cured by the Pető-method[2] effectively applying the described principle practically. Beyond babyhood they they must be educated as residents of a special institute by "conductors", teachers of the Pető method. Even the most serious cases are treated in groups. At first, in some days, the apathy stops, but with the gravest cases years are necessary to the full or nearly full orthofunctional rehabilitation. This not only means to be freed of the symptoms but to grow up to an active member of the society as well.)

Hence development of personality as shown for the baby is really based on cooperative educational inter-relationship, the interruption of which makes the child dysfunctional and its restoration orthofunctional. It follows by the given example regarding development of personality that it is connected

with the development of other personalities.

And this is the end of our detour leading to the problem of consciousness the original goal.

Conscious orientation

Consciousness appears for the child in cooperative educational inter-relationship with its mother creating consciousness of her baby involuntarily. Speaking about development of personality in fact brain's work has been described changing in cooperative educational inter-relationship on an intercerebral way.

To explain the origin of consciousness following aspect of brain's work should be considered. Input data flow into the brain permanently from outer and inner receptors. Brain by its output controls each action of the organism which also means behavior of the individual. Input and output of brain is connected by the pattern of comparision and regulation. This is enough to the intended explanation if the following improvement is accepted.

The output of the brain also contains a preparation for the expected input. This anticipation will be used in comparison with the real input for strengthening the extant pattern if no discrepancies originate, while for its changing, if they do. This makes the re-afferentative control of brain's work by the term of von Holst.

Also active speaking of the child comes under reafferentative control at first in respect to the articulated sounds. However, the transmitted information also enters into the brain through the input gate as it were coming from somebody else.

Here is to be added to the education of speaking by the mother that after teaching her baby to speak she also teaches to remain silent in a selective sense: "a closse mouth catches no flies", "keep your mouth shut and your ears open", "speech is silver but silence is gold", etc. And the child learns to remain silent, but this is not the primordial silence. The active speaking is flowing on continuously in man's awakened state (and in the sleeping state during dreaming as well) but toned down below the hearing threshold as an inner speech at most occasion. The inner speech is though an output (the rudimental activity of the vocal organs have been shown) and it enters re-afferentatively as an input into the brain as well. The carried information will thus be an input too accepted into the comparative-regulative process of brain. Thus consciousness is created. Consciousness is then an inter-cerebral (speech) connection restricted to the self's brain.

It seems for the first look a superfluous phenomenon as information is accepted by its giver,but this does not change its inevitable generation in the described process[3]. At the same time by consciousness language a common agent of intercerebral cooperation gains independent influence on brain's activity creating the orientation of the personality. Language is sustained by a multitude the members of which apply it for the aid of cooperation as shown in the case of the mother and her baby. The greater the individual's ability for cooperation is, the more self-sufficient s/he is which refers to the orienxtation as well. Individual orientation is expanded by the ideas of

the learned language, which is learnt in cooperative educational inter-relationships. These are instrumental in the incorporation of the concepts of language into the activity of the individual brain. The intercerebral process resulting in the improvement of the solution of rising problems extends to verbal communication too generating a c o o p e r a t i v e h e u r i s t i c s . Development of the individual personality regarding its orientation is affected by the language and language is affected by the orientation of the individuals causing a gradual change of it. Language, of course, is not only composed of words, expressions, but also of ideas, principles, value judgements. The same motivation which operates in increasing the development of personality is creating a force to change the language and this is the driving force of the development of scientific knowledge, too.

And so the two former questions ar answered. The drive for scientific knowledge is originated from that change of brain's activity by intercerebral cooperation which makes possible the solution of common problems. Scientists in their researches of a deeper understanding of reality are representing this drive unconsciously.

Cerebral aspects

Scientific knowledge supports conscious orientation of the person and hence development of personality. However, development of each personality is by cooperative educational inter-relationships connected with the development of other ones.

Development of personality is due to changes in brain's work by intercerebral influence. Groups of highest variation consist of individuals facing problems of reality/to be solved/ by adequate intercerebral cooperations as human action is brain's output and the individual brain gets the necessary abilities for the solution of problems by intercerebral influence.

Human problems have some change from generation to generation. Changes modify knowledge accumulated in the group. As errors appeared evidently growth of suspicion about knowledge created modern science. It is based on the effort by which influence of reality can be augmented upon knowledge. Using experimental method of measurement science discovered more and more quantitative connections.

Extension of knowledge starts with a new idea. (Even a changed old idea is a new idea.) However, where are the new ideas coming from? This is a question about creativity. The new ideas are created by creativ people, they are the discoverers. They are creative by their brain's work.

Each brain makes changes for the extant pattern if discrepancies appear in the reafferentative process. Certain parts of the pattern will be exchanged and the variation extended systematically. It seems that patterns as a whole and their parts and subparts are always plural which is advantageous for alteration. Play is a manifestation of preparation for changes and its biological importance is clearly seen

from the wellknown strength of its motivation. Children in no way can be forced to leave plays alone permanently. However, there exists a perceptible tendency to restrict variations in brain's work. It is difficult regarding children to distinguish play from creativity, and while they grow up the mentioned restrictive selection of society extinguishes brain's variability of majority making them conformists. Certain individuals keep the variability of brain's activity and create new ideas accordingly.

The mentioned variability of brain's work is experienced from the blabbering of the baby through the wellknown luxury of movement in children till making jokes , and acting impiously etc. This type of variability is canalized selectively in the same sense as the mother in the above example did with her child's babble in teaching of active speaking. In respect to science (and fine art) Timiriasev[4], the Russian Darwinist indicated that creativity based on variability and selection. As a corroboration among others he quoted the following words of Poincaré, the French mathematician: "creation, discovery is differentiation, selection".

The invention of new ideas is possible by the variability of brain's work, while selection comes of reafferentation and intercerebral influence as well.

However, ideas may put obstacles before extension of scientific knowledge too.

A psychophysical approach to brain's work

In the followings it will be shown how physical research was bogged down by a philosophical error and the correction of which made free the study of brain's work together with its relation to consciousness as well.

The refered psychophysical phenomenon is rather wellknown. There is a light of regular fluctuation of intensity, ie. a series of flashes following one another. If the frequency of fluctuation is rather low, the light is seen as flickering. This sensation will change to that of a steady light by the rise of the frequency. It was Andreas Segner (1704-77) physician and physicist who took the first inquiries about that phenomenon in the sense of modern physics. It means he described it on such a way which made collection of relevant data of measurement possible. It is indicated here that physical research begins with a definition of a phenomenon instrumental in collection of quantitative data studied in the followings by their mathematical order. This will be used for the re-definition of the initial notion disclosing thus a new step of quantitative data collection and so on. Physical research is thus a variation of ideas successively, interpolating before each step a quantitative recourse to the studied phenomenon. Changes of the starting idea inevitably extend to other ones making the territory of research increasing.

Segner described the mentioned phenomenon as follows.

Human sensation is limited by the smallest discernible in-time interval. This is attained by the rise of frequency of repetition of flashes abolishing the sensation of flickering light which will be replaced by that of steady light. Segner's description of the phenomenon can be used to take measurements about the limiting frequency and he carried them out[5] which made him the ancestor of researchers of that critical freqency.

In all respects for all these scientist and their findings especially for the discovery of a correlation between the magnitude of the critical frequency and that of the light's intensity (Ferry-Porter law) I am sorry to say that no mathematical order of the measured data appeared. Therefore the physical research of the phenomenon could not break out of its rather circumscribed circle. More than two centuries went on since Segner's experiments. Consider the progress of physics in the same time regarding other studied phenomena.

I believe that it is a heuristic principle of general relevance that concerning such cases the description of the phenomenon should be suspected as being an obstacle. At the same time it is of epistemological importance that the needed change meets antagonism ("inertia of ideas").

But how to describe the given phenomenon in a different way as did by Segner? It requires only a careful attention. A light of regular fluctuation of intensity is seen. Under a certain limit each frequency is observed flickering uniformly. Hence flicker is the same quality of sensation caused by the

regular fluctuation of light's intensity independent of frequensy save its highest limit. Only the highest limit of flicker's quality can be specified quantitatively. By this frequency the sensed quality changes from flicker to steady light. This second quality also refers the same light of fluctuating intensity. It is also independent of its frequency save a lowest limit, where it ends with a qualitative change. It clearly follows from this description that instead of one phenomenon we have two ones. Both are qualitative sensory perceptions, one having a quantitative limit of increasing frequency and the other a quantitative limit of decreasing frequency. (Are these limits identical or not, it is another question.)

Let us select now for measurement that frequency at which the steady light by decreasing of frequency changes into flicker, i.e. C r i t i c a l F l i c k e r F r e q u e n c y (CFF).

However, before any measurement the justified accuracy is to be stated, statistically. CFF data should be registered under the most identical conditions, i.e. as parts of CFF data series for the same subjects. The distribution of magnitudes of differences between two subsequent CFF data, each pair selected randomly, should be studied. Even if accuracy of frequency is extended to the tenths of cycle per second The Gauss curve of distribution of magnitudes was sharp, more

than 70% of the cases remained between ±.2. Therefore CFF is to be measured by the tenths of c/s.

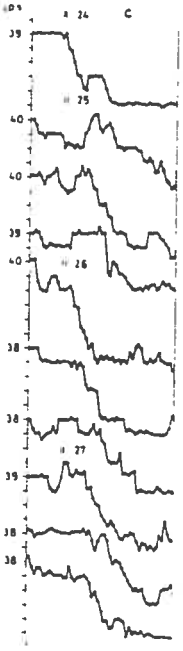

Figure 1

If CFF data are collected under most identical conditions, i.e. by series, they have a great variation all the same. However, if series of 50 CFF data each are registered without a break for the same individual and the data of a series are ordered by the succession of registration, there appears a certain likeness between the curves of the same person. (Figure 1)

The general shape of these curves is that of the wellknown adaptation's curve i.e. a decrease with a decrement. Figure 2 shows the envelope curves of 1590 series. The highest and the lowest of each five CFF data of a series have been selected for computation of the respective means.

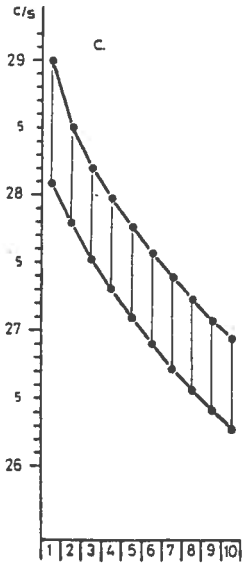

Figure 2

The manifested regularity of the magnitudes of the CFF data requires an improvement of the initial definition of the CFF phenomenon. It is under the mentioned identical conditions not an absolute but a changing limit, while its change is caused by the C F F S e r i e s E f f e c t [6].

In the sense of reductionism this is a stetement about CFF phenomenon connecting it with sensory adaptation. This should be checked quantitatively.

In a series of CFF data the next following one is with a certain probability known in before its measurment by the previous ones. However, if the frequency of fluctuation after fusion (change from flicker to steady light) is risen ten or twenty c/s higher for one-two seconds, which is imperceptible, the next CFF data will clearly be higher than expected. The rise is proportional with the increase.

Similarly an opposite decrease is attained by lowering the frequency of the previous CFF. The power of influence of frequency upon the CFF seems in its symmetry analogous to that of sensory adappation. (Compare e.g. the change of visual acuity coming out of a dark room to the sunshine and vice versa.)

At the same time it became evident that brain's work is quantitatively impinged by these frequencies which contradistinguishes it from consciousness.

The concept of CFF phenomenon was instrumental in the discovery of CFF Series Effect, the study of which clarified variation of CFF with reference to some laws and initial conditions as physicists say. Based on these findings CFF phenomenon can be described again as follows.

The stimulus of the fluctuation of light's intensity creates two patterns in the brain simultaneously, Both are in

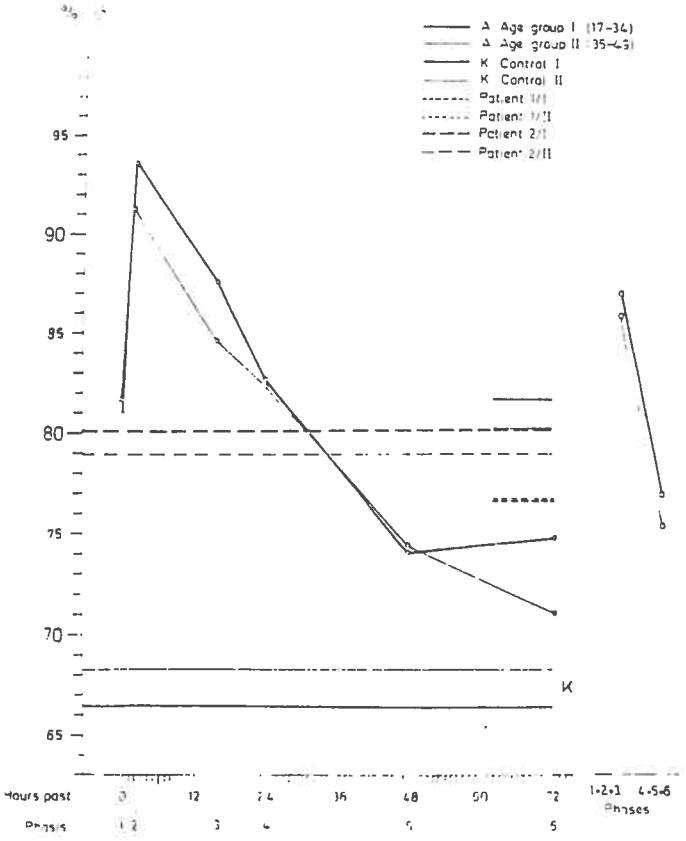

Figure 3

their relative strength influenced by fluctuation's frequency quantitatively but in an opposite way. They rival for the dominance of the output, and the stronger one for that moment will prevail. The pattern of differentiation is strengthened and the pattern of integration weakened by the lowering of frequency and when the first one takes the place of the second one in the output the conscious sensation changes.

It is to be seen that in consciousness a qualitative, verbal phenomenon appears alternatingly with reference to quantitative frequency dependent simultaneous patterns in brain competing for the output. Concrete relation between brain's work and consciousness became separated just as the feed back type origin of conscious phenomena became obvious.

And here ends my account about the CFF phenomenon as I wish not expatiate upon the theoretical and practical application of the CFF Series Effect as PSYCHOCHRONOGRAPHY (PCG) for evaluation of brain's working capacity in the given time. However, it may be of interest to show how by these researches using a strict physical method such a par excellence conscious phenomenon as r e s p o n s i b i l i t y appears quantitatively.

Doctor Uray of the Department of Surgery of a Hungarian medical school applied PCG method to decide what impairment anesthesiologists suffered by the inhalation of narcotics in the operating room. Figure 3 indicates the results both for a group of anesthesiologists and another one of healthy controls of 20 members each. The "G" characteristic of PCG is the per cent ratio of two variation ranges. "A" variation range is the ~~diffe~~ difference between the highest and lowest CFF data of the first 30 ones of a series of 50 CFF data registered without any break. "B" is the variation range of the 50 CFF data. G = 100 A/B . If variation of CFF data would be a linear function of the serial registration, G should be 60%. However, it is by average higher which is to be expected of the curves in Figure 2.

All groups in Figure 3 are divided in two age-groups (17-34 and 35-49) for the sake of statistical control of the respective means. Means of G for the two control groups are 66.46% and 68.36%. The same for the anesthesiologists are

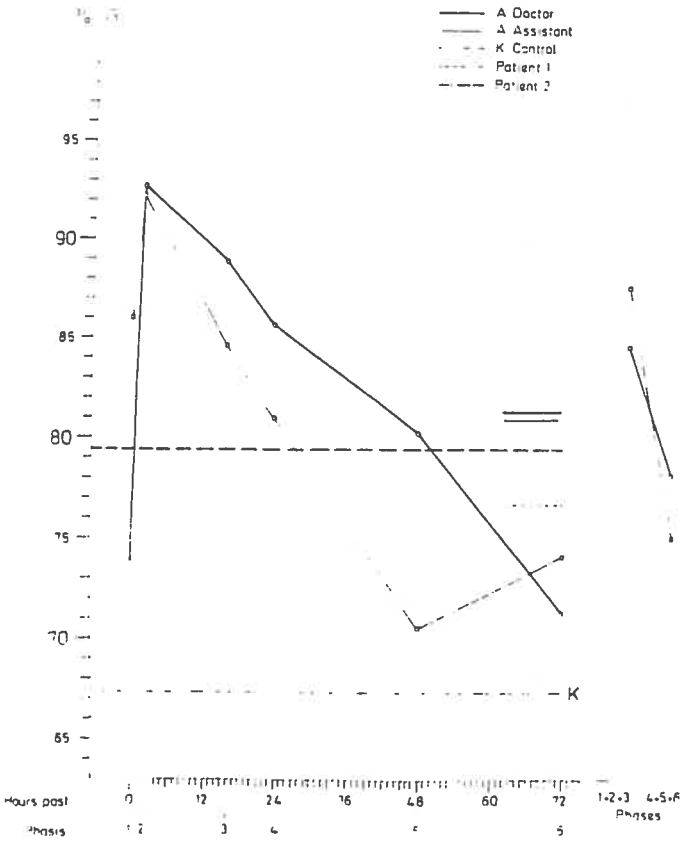

Figure 4

81.79% and 80.27%. (Each age-group contains 10 members.) Figure 3 at the right side shows the means of anesthesiologists by their first and las three measurements. (The first examination was made immediately after they left the operating room, the second one two hours, the third one 16 hours, the fourth one 24 hours, the fifth one 48 hours and the sixth one 72 hours later.) The difference between the anesthesiologists and the control is in accordance with the amount of narcotics inhaled and discharged subsequently. (For the first means the difference between anesthesiologists and controls is extremely significant, p .0000006)

Figure 3 indicates by two age groups coming from two groups of mixed hospital patients in our[7] collection their means of G too. It becomes evident that G characterizes the general state of h e a l t h quantitatively. The more it deteriorates the

nearer is G to 100%. (An example: healthy children 63.69%, convalescent ones: 75.63% and epileptics: 82.10%.) Figure 3 indicates thus a transient deterioration of health for anesthesiologists by exposition to narcotics and regeneration in the following 72 hours. However, I wished by this Figure call your attention to the rather enigmatic findings by the first examination: a low G in the time of the highest intoxication. This is explained by the Figure 4.

Here the group of anesthesiologists is divided into doctors (8) and assistants (12) equally represented in the former two age-groups. Coming out from the operating room doctors have a rather low G (73.83%), while assistants a high one (86.05%). Their difference is significant (p=.025). Two hours later the means of G for both groups are nearly equal pointing to the same health damage. It seems that the greater responsibility,i.e. more complex function of doctors has a compensating effect on the intoxication surpassing that of assistants. Doctors must pay for this result with a tardyness of regeneration lagging a day behind that of assistants.

In sum, I wished to show that in science research starts with a new idea by which data can be collected and compared (quantitatively at best). Thus the original idea will endorsed or changed. Scientific knowledge is thus returning repeatedly to the starting point, while developing in a sense of extension to related ideas.

It has been indicated that no development was possible without new ideas (psychological scotoma) and if an idea mixed together two distinct phenomena. So, Popper's idea about falsification is supported here with some concrete arguments.

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