Newton‘s Diffraction Experiments

and their Historical and Philosophical

Consequences

Helmut Nieke

I. Historical consequences out of Newton’s diffraction experiments

II. Philosophical consequences out of Newton’s diffraction experiments

III. Brake blocks for progress in physics

IV. Vortex hypothesis for structure of matter

Translation of: H. Nieke: Newtons Beugungsexperimente und ihre historischen und philosophischen Folgerungen. Halle 1997, Comp. Print 2.
In cooperation with Dipl. Ing. Axel Aderhold.

Halle 1997
Comp. Print 4: Dr. rer. nat. habil. H. Nieke, Ulmenweg 3, D-06120 Halle (Saale), Germany.
Table of contents

Page

Survey

By Nieke, [12] was shown that Fresnel's alleged proof of wave based on an inadmissible and wrong extrapolation of the formula of diffraction at slit to the distance nought. For it the proof of Newton for the transition of inner to outer diffraction-fringes and the localization of bent light was disregarded, which is the key for understanding diffraction; and not the two border-line cases of Fresnel with the inadmissible and wrong extrapolation above this transition. Then this was accepted only for Newton with punctiform light-particles could not explain diffraction with his mechanics. So from 1850 in text-books diffraction were described by Fresnel with waves as sole possibility. Newton's diffraction experiments were intercepted and therefore was introduced a simplistic and mislead theory. Also after discovery of light-electric effect at beginning of our century nothing was changed at this and the dualism of wave and particle was deduced.

Bohr had built up his quantum-theory with the Copenhagen-interpretation on the dualism of wave and particle, which he connected with the indeterminism at quantum-processes, out of the indescriptness were deduced. Against this Einstein offered contraction, but he did not consider Newton's diffraction experiments, so he could not found his opinion. Also if he had considered this, he not could have offer an alternative.

First after 1960 was possible an alternative, where the structure of elementary particles was discovered; but this did not happen, because to this time Heisenberg-Bohr's quantum-theory was accepted.

In part I of his paper the historical conclusions are considered which are caused by non-consideration of Newton's diffraction experiments. In part II the philosophic arguments are considered which are caused by the same reason.

Heisenberg deduced for structure of photon the formal model: side by side laying fermion and antifermion with spin and antispin. Consequently here is considered the photon with structure, and the spin not as spin-quantum-number but as spin- rotation- or descriptive vortex-aggregate.

Analogous to Heisenberg is accepted as structure of photon the structure of electromagnetic vortex-pair. Diffraction is founded by interaction of photon with its field according vortex-dynamics.

As appendixes are put together the brake-blocks of physics in part III, and are considered the statements of vortex-hypotheses for building of matter in part IV.

I. Historical consequences out of Newton's diffraction experiments

Index

page

1. Survey in historical periods

1.1. Collection of facts - From Newton to Young - 1600 till 1800

Newton submitted extensive diffraction experiments, which exclude the wave-structure of light in accordance to our present knowledges, but diffraction could not be established with punctiform light-particles. At this time light was valid consisting of light-particles.

1.2. Calculations with waves - Fresnel - 1800 till 1900

Fresnel could calculate border-line cases of diffraction with originated the theorem by his countryman Fourier. He reported his results of measurement only when they sufficiently agree with his theory. If this did not agree, he broke off the information without remark. Newton's diffraction experiments showed what the diffraction still characterizes outside Fresnel's introductions, but this did not suit to wave-theory, hence there was inadmissibly and wrongly extrapolated to slit-plane. So Newton's experiments were omitted, intercepted and disregarded. There an incomplete and with it misleading theory of diffraction was propagated.

1.3. Dualism of wave and particles - Einstein and Bohr -1900 till 1939

The discovery of light-electric effects after 1900 demanded light as particle. For farther with punctiform light-particles, light-quanta or photons diffraction did not be to establish, ensued as philosophical solution, the dualism of wave and particle. Bohr established his quantum-theory on this dualism and indeterminism in quantum-processes. Einstein struggled against but he could not establish his refusal for he did not noticed Newton’s diffraction experiments. Particulars are to find in the seventh part of this paper.

1.4. Dominance of Heisenberg-Bohr's quantum-theory - 1945 till ...

The discussion Bohr - Einstein was took for executed and the Copenhagen-interpretation was praised as modern physics. Only a few peoples opposed against it.

1.5. Fusion instead dualism - off ...

Einstein demanded a fusion of wave and particle instead of dualism. This was first thinkable as about 1960 was discussed a structure of elementary-particle. The photon with structure and field could explain diffraction by change of direction with which were superfluous dualism and indeterminism.

The farther sections are disposed in real part-spheres in which are pursued the historical development of diffraction.

2. Grimaldi's luminous edge

2.1. The luminous edge from Grimaldi to Fresnel

First Grimaldi 1665 [1] reported about diffraction and moreover about the luminous edge. The luminous edge is to observe if a source of light is masked by a half-plane. The paper of Huygens [2] was published after Grimaldi but before Newton [3]. Huygens wrote about diffraction (translated): „... I term it namely wave because the likeness with that which is seen forming at throwing a stone into water; because these perceive a spreading in round, although they escape an other cause and form themselves only in one plane.“ Else he accepted the spreading of pushing ether particles, at which the expla nation of transparency is lighter for him than opacity since ether should be existing everywhere. As Descartes and Fermat he considered velocity of light in high-refracting medium smaller than in air.

Newton [3] III observation 5 (1704) inspected more accurately these phenomenons of luminous edge and established that the fine light line was so smaller so more lateral he observed. He found the breadth of this line about 0.03 mm.

Young [4] viewed a slit sidewards and found the shadow-side luminous edge as Grimaldi and Newton but also the light-side luminous edge. Surely Newton had observed this fact too, but he could not exclude the possibility of reflection at the edge and so probable he did not report about that. The work of Young is regressive opposite Newton because he limited diffraction to the edge instead of the surroundings of edges as Newton. Young supposed that from every edge are starting spherical waves. Young considered diffraction and luminous edge as 'an art of reflection' at the edge, where he probably

thought of a stimulation of the edge, which is not possible with visible light as we know now. With his interference principle he could explain diffraction at double-slit and grating, at which diffraction at double-slit served peculiarly to establish the wave hypothesis of light.

Fresnel [5] confirmed explicitly in his first paper about diffraction that he has convinced himself that bent light comes only from the edges, what never he respected later.

To that time the existence of luminous edge as a physical phenomenon was acknowledged generally. It was not necessary to emphasize that bent light does not come from the whole slit for this was self-evident.

2.2. Further papers about the luminous edge

What was self-evident in the time till Fresnel, that bent light comes exclusive out of the surroundings of edges, was since about 1850 no more described and no more reported. Newton's diffraction experiments were concealed, so this fact was later new discovered, but these papers were not noticed.

Kalaschnikow [6] reported about the silhouettes of needles in the field of bent light. There was shown unequivocally that this light was coming from the edge, he could not find out by this method the extension of a sphere.

Rubinowicz [7] started his survey about Miyamoto-Wolf's diffraction-wave with the sentence: „We know very well from our daily experience that edges of illuminated objects shine when observed from their shadow.“ He directed to Newton [3].

Shoucri [8] wrote (translated): „It seams that Fresnel ...did not consider this interpretation of the boundary wave, which had led him certainly to an explanation of Young's introductions in agreement with his own theory.“ That is not right, for Fresnel had seriously examined this and he got no right result for diffraction at slit. Shoucri could reach with fitted subtraction out of Fresnel's zonal-construction an agreement. That is not according Young’s conceptions but a formal mathematical trick. So he wrote: „The phase-jump of π is here without further acceptances introduced by subtraction of the edge-wave.“ It is an often used method, if the calculation in diffraction or interference do not gave back the experiments, to infer a fitted phase-jump. So the theory is all right in every case, but there is used the Fourier theorem, with which every experimental result is exhibitable. But at this is something in. According section 5 shadow-side bent light is coming from the slit-jaws, it has to be displaced sideways.

The non-consideration of Newton's observation of extension of Grimaldi's luminous edge, already by Young, made possible the mislead denotation as edge-diffracted- or edge-wave and the useless attempt for their exhibition as line-integral.

On historical views about Newton's diffraction experiments lay before some papers. Rosenberger [9] meant to Newton's diffraction experiments that they do not got out much about already by Grimaldi's made discovery. Laue [10] do not mentioned Newton's diffraction experiments, just as in his handbook-article. Hall [11] gave an Introduction to Newton's optic's. He confirmed that Newton had worked very carefully in diffraction, but he did not pointed out the IIIrd book.

2.3. New experiments

Nieke [12] showed the existence of luminous edge, their position, and their breadth < 0,1 mm (dependent of the aperture of optic for imagery). He substituted the eye through a photographic camera which he placed so sideways that no direct light could hit the objective of camera. The focusing to the slit ensued with incident light and with it the position of edge was marked.

Nieke [13] showed that the diffraction figure of double-slit is existing even the so called coherence condition (please compare section 4) is extremely violated. This ensued if the illumination slit has such a width that the first or a higher order fell on each single slit and the zeroht order on the intermediate stick.

Ganci [14] streaked with the light of a laser a half-plane and he focused the light with a cylindrical lens on the intermediate stick of double-slit. Nevertheless the bent light yielded the diffraction of double slit even here the so called coherence condition is extremely violated. Ganci tried to explain this result with Rubinowicz‘s transformation of edge-diffracted wave and basic philosophy.

In both cases the experiments from Newton [3] give the explanation: Bent light comes only from a small surroundings of every edge of slit or half-plane. For these small planes for illumination

are fulfilled the so called coherence condition. The unbent light is masked in both cases by the intermediate stick of double-slit. Every slit has two small surroundings of bent light and therefore Nieke [13] could explain his experiments with analogy to the double-star experiment. The double-star is substituted by the two surroundings of edges from which bent light is coming.

3. Diffraction at slit and half-plane

3.1. The diffraction at triangular-slit by Newton

Newton [3] III observation 10 showed a complete survey about diffraction at slit with a triangular-slit. Figure 1 shows Newton's drawing and thus the justification to criticism of inadmissible and wrong extrapolation with the only use of outer diffraction-fringes. Because the transition from inner to outer diffraction-fringes could not be explained, therefore the drawing of Newton was not taken over by the authors of textbooks about optics.

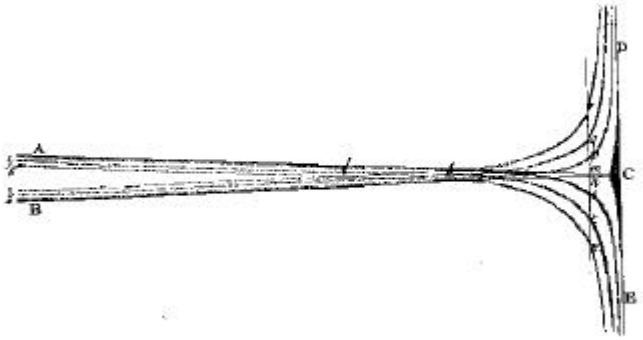

Figure 1. The diffraction at a triangular-slit after Newton [3] with sun light, a small hole in the shutter, distance to the triangular-slit 10 feet, and to the drawing plane 9 feet. ABC -projection of slit = shadow-limits. With sun light originate tree coloured fringes, with monochromatic light corresponding more.

In the right part at small slit widths are to see the hyperbolic outer (outside ABC) diffraction fringes, which are exhibited in text books as sole possibility of diffraction at the slit. They have equal angle intervals, reciprokcal to slit-width, the intervals increase proportional to the distance.

In the left part of the inner (inside ABC) fringes run parallel to the shadows of slit edges. These fringes correspond to that of the half-plane. The intervals of these fringes are not equal, they become light-side more narrow. Their intervals grow at parallel incident light only proportional to the root of distance.

With rising distance of triangular-slit to drawing plane the limit of transition of inner to outer fringes wanders left, so that in very large distances originate only outer fringes. Newton (III query 3) inferred out of this fact that light have to move eel-like.

Malange a. Gronowski [15] with X-rays and Nieke [16] with light found that the diffraction-figure of slit with outer diffraction-fringes (figure 1 right part) develops by parallel incidence first in distances of about d^2 / λ (d = slit-width, λ = so called wave-length). In shorter distances originate the inner diffraction-fringes of the slit (figure 1 left part) which correspond to diffraction at half-plane with the edges as half-planes.

The transition from inner diffraction-fringes in short distances and large slit-width to outer diffraction-fringes in great distances and small slit-width is not to put away, that suffice separated edges have to deliver the diffraction-figure of half-plane. But it is to explain why with equal slit-width in short distances appear inner and in large distances outer diffraction-figures. The trial by Schwarzschild [17] through 'throwing across' of solutions from one edge to the other, never was acknowledged as solution of this problem. Malange a. Gronowski [15] attempted a computer-program for interpolation.

General, Newton's diffraction experiments were intercepted or concealed for being to explain neither with light-particles nor with waves. So inner diffraction-fringes of slit not only in all text books of physics simple left out, but also in hand-books as Laue [18] where only was shown a photo by Arkadiew [19] in extreme large distances where only outer fringes appear, without a hint to inner fringes. By Nieke [9] the diffraction at the triangular slit is documented with photographic pictures.

3.2. The origin of wave-interpretation off Fresnel

With Young's interference principle which was successfully used at least in great distances to explain diffraction at the double-slit, Fresnel was not successful in calculation the diffraction figure of the single slit with outer fringes with the acceptance that bent light is coming from the edges. Also in great distances the positions of minima and maxima of outer fringes are not to calculate rightly, as it is light to verify. Therefore Fresnel [5] used Huygens' principle.

Nieke [12] verified Newton's and Fresnel's diffraction experiments. Newton's statements agree also there where he could not explain them. Fresnel's statements of measurements agree too but exact there where the experimental measurements were not in agree with his theory, exact there he broke off communication of his results without hint.

The place of maxima and minima of outer fringes of slit (outside of shadow-limit) in great distances is to calculate easily. This is to see in Newton's drawing fig 1 right part. So is well-known for maxima and minima:

$$\sin \alpha = m \lambda / d, \qquad (1)$$

At slit: Minima $m = n$ with $n = 1, 2, 3, \ldots$
Maxim $m = 0$ and
$m = (2n + 1)/2$ d = slit-width
At double-slit and grating:
Maxima $m = n$ with $n = 0, 1, 2,$
Minima $m = (2n + 1)/2$ d = slit-interval

with m as measure-number of order n. This formula was extrapolated to the distance nought, therefore in the slit-plane, and one inferred from this that the slit limited a wave-front and every point from this wave-front is a starting point of a new spherical wave. Fresnel tasted it therefore with Huygens' principle together with Young's interference principle (today known as Huygens-Fresnel's principle), where diffracted light should come from the whole slit. One ignored appearance of inner fringes (fig 1 left part) and of luminous edge which Fresnel had confirmed formerly.

To Fresnel [5] is to remark that he executed his experiments above all at hindrances and with divergent light where the transition from outer to inner fringes take place in larger distances. Then he had with accent this transition called attention his opponents to the weak-points of his theory. Therefore he tried to keep this dark with two separate statements by half-plane and slit. Fresnel was not acknowledged at once, because there were too many persons which know Newton's diffraction experiments. But on this inadmissible and wrong extrapolation of diffraction at slit by formula (1) to the distance nought established not only Fresnel his theory but also after 1900 originated the dualism of wave and particle.

However, not everyone has to verify experimentally Fresnel's experiments over validity of his theory, but it is enough to convince of the inadmissible and wrong extrapolation of formula (1) for diffraction outer fringes at slit, if one respected the hitherto intercept diffraction experiments of Newton.

Herschel [20] wrote 1831 (translated): „It seams therefore that Fresnel in his objections against these things of Newton's theory, self had no distinct conception of the theory of which he is an opponent." Biot [21] entered 1829 detailed in the undulation theory, but he advocated the corpuscular theory and he confessed that it can not make statements over the forces of diffraction. He wrote (translated): „But it seams very difficult and it is probably that, if there exist such forces, there characters are different from the habitual appearance offered by refraction and reflection." Here he indicated the essential problem of theory of light-particles, it could not give a cause of sideward turning, where as water-waves show this effect.

But than Newton's follower died out and about 1850 physical text books, which will explain every thing, simple left out Newton's diffraction experiments. An argument for that Newton had given self as he accepted for explanation of refraction to the optical plummet at entry in an optical density medium the work of a force and so an acceleration of the particles of light. Light should have so in the denser medium a higher velocity, what later measurements did not confirmed. But the conclusion was wrong, with that was refused the theory of light-particles. Its only right that with it is excluded the possibility of treatment light particles as mass-points.

Buchwald [22] reported about the battle between Arago and Biot over Fresnel where he did not enter into luminous edge but to personal differences and polarisation. In the following time these

discrepancies were not valued but important appeared that Fresnel was succeeded to explain and calculate the diffraction of slit. That this was only valid for large distances and succeeded with wrong initial positions, was not noticed in the following time.

In contrast to the fact of localisation of bent light and the existence of inner fringes, are the schematic plotting of Bohr and in many text-books for example Orear [23] where the outer diffraction-fringes, which originate only in large distances (figure 1 the right part), are traced till the slit or double-slit. These exhibitions show that these authors have regarded never diffraction rightly, that is also in proximity, then they had seen that in short distances appear inner fringes and bent light comes only from the surroundings of every slit. But the authors relied to Fresnel without inspect.
Natural for criticism is to consider that particle-structure was proved first 1900. The light-particles of Newton were only proved indirectly, above all with localization of bent light, and as mass-points never diffraction were to establish with Newton's mechanics.

The often called sentences are wrong with safety: 'Diffraction and interference are to explain with waves and only with waves' and: 'A wave front falls upon a slit and then there are possible only probability statements'.

3.3. The diffraction at half-plane

Fresnel [5] could calculate the diffraction figure of half-plane with help of Fourier theorem. He found experimentally the dependence of distance of diffraction figure. With parallel incident light grow the intervals of diffraction fringes only with the root of distance. These experimental results were set in theoretical formulas and did not come out of theory.

Nieke [16] ascertained the dependence of diffraction-figure of half-plane in very short distances at parallel incidence light. The known diffraction-figure appears first in a distance of about 50 mm, general in $10^5\ \lambda$, as Hiller and Ramberg [24] found with defocused electron-microscopic photographs if the so called wave-length is used as comparison.

3.4. Later theoretical papers

Hönl, Maue a. Westphal [25] gave an extensive review, without mention of Newton's diffraction experiments, here only conservative topics are discussed.

Kirchhoff 1824-1887 [26] proceeded from the elastic theory of light and therefore from vibrations of ether with the wave equation

$$\delta^2 \varphi / \delta t^2 = a^2 \Delta \varphi \qquad (2)$$

He introduced Huygens' principle in coordinates manner of writing and integrated over the free plane of light. The consideration of phases of waves corresponded formal to the periodicity of light as already Young supposed with his interference principle. Here the boundary values or boundary conditions influenced authoritatively the results. These values are arbitrary and only the success justify. Kirchhoff supposed that between the slit edges is existing the original field and outside the value zero and $\delta\varphi / \delta N = 0$ (N - normal). This disposition leads naturally to unsteadiness and this was objected often. Nevertheless it was acknowledged that in great distances and specific cases often is presented a good agreement with experiments.

Later all authors proceeded from the electromagnetic theory of light but there resulted practically the same formulas. The boundary condition if black or bright screen was often discussed, although the experimental values show practical noticeable deviations only in extreme cases.

Sommerfeld used the for specific planes reduced boundary condition by Maxwell $E_{tang} = 0$ and $B_{norm} = 0$. For his work is characteristic the use of Riemann's planes, especially for diffraction at half plane. Sommerfeld [27] wrote to Huygens' principle (translated): „The in Huygens ' principle used boundary values are not only in the nearness of edge but till up to $\sqrt{}kr$ different from the in our sense exact boundary values. It is to astonishing that the classical theory of diffraction yield nevertheless so practical satisfy results."

Rubinowicz [28] performed the theory of diffraction with function theoretical manner, with which it is possible to transform a line integral into a plane integral. Presupposition is natural that the light propagation figured to an analytic function what Huygens' principle permits written as e^{-ikr}/r. The line integral is interpreted as expression of Young's conception that bent light comes from the edges and the plane integral as an expression of Huygens' principle that from every point of the wave front is starting a new spherical wave. Here formal both forms appear completely of enjoying equal rights, although they represent two physical complete different opposed facts which excluded another. Both

do not correspond to physical facts and serve only for quieten of minds. By splitting up diffraction formulas in two parts he considered always the boundary part as essential. Rubinowicz [29] reported summarily. Kottler [30] received with Kirchhoff's boundary conditions with a count-back not the same conditions. So he substituted the boundary problem by mean of a discontinuity problem. With differential equation, Green's sentence, and plane integrals he ascertained so the intensity of the test point. Kottler [31] gave a survey in a review report.

But all these theories did not note or quote Newtons diffraction experiments. That are only mathematical approaches for large distances which are inadmissible for physical interpretations.

3.5. Critical considerations

Diffraction- and interference-experiments were valued often as proof of wave-nature of light. That is not right for already Mach [32] remarked that these experiments prove only the periodicity of light. Periodicity can be conditioned differently, not only by swinging or wave. In every place of a diffraction- and interference-figure is to prove with help of light-electric effect the quantum-nature of light, and the absence of an accumulation-time (as wave-nature demand) excludes wave-nature for the light-electrical current set in practical inertless. Also the possibility of a mathematical exhibition of diffraction in special-cases with circular- or e-functions with complex exponents is no proof for existence of wave for rotation is representable just so. Every function, which is piecewise monotonous, is exhibitable by use of Fourier's theorem as mathematical formalism, in any case these are fulfilled for experimental results. The periodicity of light favoured this representation but does not prove the wave.

If formula (1) is extrapolated to the distance zero and inferred that the slit limited a wave-front and every point of this wave-front is starting-point of a spherical-wave so is this extrapolation inadmissible and wrong. Already Newton [3] proved that in short distances first arise inner fringes of slit which do not obey formula (1), and bent light comes only out of a small surroundings of every edge.

If one conclude this out of the differential-equation (2) so are valid the same arguments for there is integrated in the slit-plane over the free plane, and bent light does not come from the whole slit plane.

Diffraction results not only in one change of direction of light-particles or photons in slit- or hindrance-plane but in the space behind too. Newton established rightly: Light run eel-like. Behind the diffraction-plane photons are not running at once rectilinear as in section 5.2, 5.3 and by Nieke [16] are called experimental proofs.

4. Diffraction and coherence

4.1. The coherence-condition as interference-angle-condition

In examinations of diffraction at the slit, above all at double-slit, was observed that the light source (or illumination-slit) dares not be great as pleasure. Verdet [33] gave for that the mathematical relation with X as extension of light-sources or illumination-slit, θ as half aperture-angle to the double-slit

$$X \sin \theta < \lambda / 2. \qquad (3)$$

If this relation is sufficiently fulfilled the diffraction figure of the double-slit appears sharply So less (3) is fulfilled so more it appears unsharply or smeared over. For that time was used the wave hypothesis of light, so (3) was interpreted generally that waves from the edges of light-source are permitted to have no greater phase-difference as $\lambda / 2$. The here discussed condition is named spatial coherence therefore as a connection of radiation.

Nieke [34] called attention to another interpretation which gave already Berge [35]. These results by consideration of the other side of double-slit, in which take place the diffraction, that is the consideration of diffraction too.

The first minimum of diffraction figure at the double-slit results in sufficient distance (as formula (1) with m = 1):

$$d \sin \alpha = \lambda /2.$$

From this with (3) follows

$$X \sin \alpha < d \sin \alpha \qquad (= \lambda /2)$$

For small angles is to place (sin $\theta = d / a$, sin $\alpha = Y / b$)

$$X / a < Y / b \qquad (= \lambda / d) \qquad (4)$$

with Y as interval between diffraction-fringes of double-slit, a -distance light-source to double-slit, b - distance double-slit to screen with the diffraction-figure.

It means in words that the angle as result of diffraction has to be greater than the angle in consequence of geometrical extension of source of light. Or: The divergence of illumination is transformed as blur to diffraction figure. With a coherence of radiation this is without relation, but with a too great extension of light source the maxima and minima of diffraction figures are distributed according the geometry of lihgt source and so diffraction figures become unsharp and disappear last.

Already Arkadiew [19] wrote that the angle from diffraction screen of opening (source of light) has to be smaller than the angle to interval of diffraction strips. Cittert [36], Zernicke [37] and Wawilow [38] established in other context that the phase of incident light has no influence on the originating interferences. In equation (4) λ get out but this does not signalled independence of frequency of light but the presupposition of monochromatic light. By use of white light the diffraction figure is coloured. For spatial interferences statements are only possible for light which is sufficient monochromatic. With consideration of participated frequencies there result fundamentally the same diffraction figures with filament lamp or laser.

Summarizing is to establish that the so called coherence-condition has no relation to connection of radiation. The denotation coherence condition is not justified and is to replace about by 'interference-angle-condition'.

4.2. The temporal coherence as interference length

To produce interferences with conventional light sources and lasers (besides two mode and phase stabilized lasers see section 4.4) it needs a beam splitting. With light as wave the establishment of splitting was no problem because waves are divisible without problem. Differently this was after the discovery of quanta of light, the photons. Here the photon can go only one way; it can not be divided because the demand of quantization. Already Broglie supposed the division of photon and its wave, what is to correct in the more general notion of the photon with its field. According to that beam splitting is the separation of photon and a part of its field. There are disposable the following methods:

a. reflection-refraction (Newton's rings, Lummer-Gehrcke plate)
b. double imagery (tilted mirrors, divided lens)
c. semi-transparent reflecting (Michelson-interferometer)
d. part-masking with diffraction (slit, double-slit, grating)
e. scattering (little particles, dusty plates, ground-glass)

To test the temporal interference ability, the beam splitting a to d is possible, at which both beams are to bring after that in the same direction. Corresponding of the periodicity of light the intensity of light changes local with difference of temporal variations. General all upper described beam splittings are dependent of frequency but here are used only little differences, so that this is mostly to neglect. With interference instruments about Michelson- or Mach-Zehender-interferometer, and gage-measuring interferometer or Köster's double-prism, can be produce two spatial divided and therefore temporal shiftable boundless of light. With these at passing over a difference length of two boundless, corresponding a temporal difference or a difference of frequency, no more interferences are to observe what is denoted as interference length (former noted as coherence length, but there is necessary no state of order). At transgression of a suffice difference the interference figure becomes unsharp, smeared or coloured, and disappear last. This appears if the frequencies fill continually the band of frequency. If only two frequencies of a double-line are present as for example Na-jellow, so the interferences disappear if one line falls in the minimum of the other. In farther differences of time again blurred interferences arise. That this has nothing to do with a state of order of radiation is easily to see, with a filter which is placed in the light path so raises the monochromasy and so the length of interference. Authoritative are only the participated frequencies.

The best natural monochromatic light sources have interference lengths of maxim a few decimetres. The band width of frequency is so smaller so lower the temperature of the emitting gas.

At interferences with lowest intensities, where only one photon could be present in the apparatus, there are found the same interferences as with high intensities, what is reported for example

by Reynolds, Sartalian a. Scarl [39]. Dirac [40] inferred out of this fact that every photon interferes only with itself and never interfere different photons (compare with section 4.4).

In the former section there could be shown that geometric conditions determine or limit the space-interference. In the time-interferences there are the given frequencies which determine or limit the interferences. In anticipation to section 4.4 it is to remark that the interference-length is influencable by stimulated emission.

If one ask where the light is remaining if the field of an interference instrument is dark so is to consider: At Newton's rings (reflection-transmission) or the Mach-Zehender interferometer always one path is bright if the other is dark, they appear as positive and negative. Light went only the other way and was not lost. At the Michelson interferometer is to notice that the second path is reflected return to the light source. Newton [41] answered to the rings, named by him, that the light-particle have 'fits' (= real fits and no caprices) as periodical change of refraction and reflection. In anticipation of section 6 this can considered as interaction of photon with its field corresponding to the difference of way-length as consequence of periodicity of light. The effect of influence on reflection-refraction, demanded already by Newton, must be existing.

4.3. Descriptions as partial coherence

Light was hitherto considered as incoherent if no interferences are visible, for example in Young's double-slit experiment. If interferences are visible but more badly as originated from a point, so light is designated as partial coherent.

Michelson [42] defined the visibility of interference fringes by the friction

$$\frac{I_{max} - I_{min}}{I_{max} + I_{min}} \qquad (5)$$

This is a pure experimental definition. Building up on Cittert [36], Zernicke [37] tried to calculate from evidences out of illumination with the wave hypothesis and two beams this as coherence-degree. So he defined as coherence-degree with A as amplitude and J as intensity with $J_1 = A_1 A_2^*$ (* conjugate complex)

$$A_2 / A_1 = J_{12} / J_1 \qquad (6)$$

what is carried on to the complex degree of coherence. By means of the Fourier theorem. and other transformations there were practicable extensive formations and adaptations and also a referring to on order of radiation what is for example reported by Vinson [43] and Perina [44].

There were not denied geometric or frequency conditions but they were not separated but mixed considered. With integration over the slit-plane is not noticed that bent light is only coming out of the small surroundings of every edge. Therefore Newton's diffraction experiments are not respected.

In the both former sections are shown that spatial and temporal coherence are dependent only on geometrical resp. frequency conditions without any reference to a correction of radiation. So in partial coherence is to consider this aspect too.

In diffraction at the half plane is designated as partial coherence if the interference-angle condition (with diffraction angle of the half plane) is not sufficely fulfilled as by Kinzly [45], Considine [46] and reported by Thomson [47]. But here are to consider only geometrical conditions and this has nothing to do with order of radiation. Nieke [48] showed that Mach's strip of an edge by sunshine is the remaining first maximum of the diffraction figure of a half-plane.

In microscopy was established that an image is better resolved if the illumination-aperture amounts only the 0.6 till 0.8 fold of the aperture of microscope objective. That is tried to denote as partial coherence for example by Hofmann [49] who defined so a coherence-parameter. With the observation of Newton that bent light only comes from a small surroundings of every edge, the interpretation as coherence is useless and unproved. If the edge of aperture diaphragm is illuminated less as result of smaller illumination-aperture, so there is less diffraction self-evident and the image appears sharper. It is existing no argument for supposing an order of radiation or the designation of coherence.

Since Zernicke [50] had invented the phase contrast method, many interventions into the diffraction figure in the focus plane of objectives are used. Zernicke did not explain this with partial coherence but justly with a sort of schlieren method. On the contrary for example Yu [51] and others termed interventions in the diffraction-figures or images of an object as result of partial coherence. They did not deny geometric or frequency conditions but they did not separate this from states of order

of light and did not pay attention to the origin of bent light. They integrated over slit planes although bent light comes only from surroundings of edges.

Different from this are interventions in the figures of holography where a state of order in radiation is to expect and to respect, here is to speak of coherence. But it is to respect that after Pietsch a. Menzel [52] Fourier optics have only a limited sphere of validity. As a physical establishment is to quote that bent light comes from the surroundings of every edge, as already known by Newton, and not from the whole slit as demanded from all diffraction theories with Huygens' principle. It is evident from the first that the physical properties are others and Fourier optics can be only a formal mathematical approximation. So wrote Menzel, Miradé a. Weingärtner [53] that first simplifications of diffraction theory permit the application of Fourier theorem.

4.4. Coherence as connection of radiation

Hunbury-Brown a. Twiss [54] pointed out that in extraterrestrial and mercury radiation coincidences are more frequently as to expect for statistical order. From this is to infer that stimulated emission is partially present also here and not only in laser. Nieke [55] tried to consider this additional in thermal radiation.

Magyar a. Mandel [56] found that two lasers can show interferences without beam splitting if they are sufficiently stabilized in mode and phase. Of course, there are to fulfil high demands. Richter, Brunner a. Paul [57] concluded from this that photons interfere not only with itself, as Dirac [40] demanded, but also with other photons if they are sufficiently corresponding in mode and phase. Also the great interference length of special lasers may be so to explain.

In suggestion of Kapitza a. Dirac [58], Schwarz [59] executed experiments in laser right-angled to the axis of length by means of electron diffraction. He found that electrons are so bent as in length direction is effective the lattice constant of one wave-length of the laser light. They spoke therefore from laser light as a light-crystal. Hence it follows that stimulating and stimulated photon should have a distance of λ or a multiple of that.

This paper shall stimulate to speak about coherence only if there exists really a state of order in radiation and not only geometrical conditions or distribution of frequencies have an influence on interferences. Hitherto this was considered mixed as for example Vinson [43] or Perina [44].

For non linear optics interference of photons is to extend as their interaction, but that is not a problem for this paper.

5. Farther experiments for diffraction

The diffraction experiments by Newton could be proved true besides to the splitting of nought order at very small slit in Newton [3] III observation 6, supplements are necessarry. Stuewer [60] considered Newton's diffraction experiments critically in comparison with Grimaldi and Hooke. He took over Fresnel's diffraction experiments uncritically. But he distinguished interior and exterior fringes. To Newton's observation 6 he wrote: „I believe the appearance of the central dark line, which I have personally verified, to be due to a physiological effect in the retina.“ He did not give an explanation. By Arndt a. Nieke [61] this is based to a physiological effect during reducing of slit-width, after a few seconds the splitting disappeared.

5.1. Diffraction at slit and hindrance

Nieke [62] examined diffraction at slit and hindrance. For that he found that their diffraction-figures are equal edge-symmetric, where inner diffraction-fringes of slit are equal to outer diffraction-fringes of hindrance which both correspond to the diffraction at half-plane. Instead of edge-symmetric is also to say that light-sight and shadow-side diffraction-figures look respective equal.

As in section 3 is considered in detail that in larger distances appear outer diffraction-fringes of slit and inner diffraction-fringes of hindrance which correspond again edge-symmetrical. Only in special cases the diffraction-figures are equal another as in Fraunhofer's manner of observation (where the light-source is imaged in the observing-plane and so only appear outer fringes of slit or inner of hindrance) if is disregarded from the central -figure. But Nieke [34] showed that outside the focal-plane of Fraunhofer's manner of observation appear again inner diffraction-fringes of slit.

Nieke [16] proved that slit and hindrance of same dimensions in a schlieren-apparatus (cf. 5.6) have the same image, hence it follows that bent light is coming out of analogous spheres relative to edges.

5.2. Diffraction following one after another

Nieke [62] illuminated out of a small disk-diaphragm with parallel light a half-plane and with its diffraction-figure was illuminated an oblique placed slit. Its diffraction-figure showed that a slit yield other diffraction-figures as with uninfluenced light, it was influenced not only the intensity but also the angles. By design was chosen a half-plane as first diffraction for already Fresnel [5] found that intervals of fringes grow not linear with distance, with parallel incident light only proportional the root of distance. For light out of photons is to conclude that bent photons do not run rectilinear and influence so the following diffraction.

Nieke [63] showed that also interference-figures are influenced if in an arm of a Mach-Zehender interferometer is set in. But the circumstances are here not so easy to survey.

5.3. Diffraction at double-slit

If at double-slit one slit is masked so results the diffraction-figure of one slit. With photons the diffraction-figure of double-slit gave a problem for a photon can only pass one slit. Broglie [64] supposed that indeed the photon passes only one slit but its wave as guidance-wave also the other slit. Born [65] corrected already guidance-wave in guidance-field.

Nieke [62] masked one slit not direct but in an intermediate imagery was masked one single-slit image. There arose the diffraction-figure of double-slit by masked single slit-image too if before intermediate imagery the light passed a sufficient long way (some decimetre). From this is concluded that the photon through its returning field received information about the slit which it self did not passed. The field caused in consequence of returning the for that due change of direction as is explained in section 6.

5.4. Diminishing of frequency after diffraction

Smekal [66] predicted in the paper, in which he predicted the Raman-effect, also that light should have a lower frequency after diffraction. Nieke [67] performed these experiments with laser and Lummer-Gehrcke plate and could show a diminishing of frequency. Yet no shift of the whole line but only a spreading to lower frequency.

The Raman-effect demanded with conventional light-sources exposure times for hours or days. With lasers the Raman-effect is to present easily. Diminishing of frequency after diffraction is to show easily with laser-radiation at the necessary small slit-widths.

5.5. Mach's strips

Mach [68] explained the to him named strips on rotating oblique limited star-formed figures with reaction on the second differential-quotient of intensity to locality at retina and photographic emulsion and as a psychological effect. Nieke [69] proved with objective radiation detectors and photographic instantaneous exposures that this is a physical effect. He led back this on a local and temporal shifting of reflection at the edge of the photon and its field during moving, therefore on a diffraction at moved edges.

5.6. Experiments in the schlieren apparatus

Nieke [70] extended Newton's diffraction experiments in a schlieren-apparatus. A schlieren-apparatus permits a separation of bent and not sufficiently bent light, for the last is caught with the schlieren diaphragm. Without object the image field is practical dark. By bringing in a slit in the optical path as image of this slit appears ever a double stripe at that places where an image of an edge appears in incident light (fig. 2 b). Every double stripe has a small dark space at the place of edge in incident light. The outer part of every double stripe seams to come from the slit jaws, consequently the shadow side bent light must be displaced shadow-sideways.

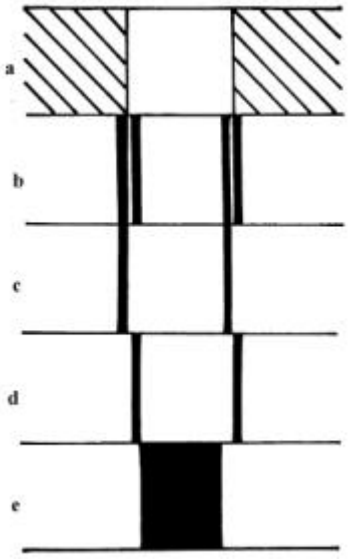

Fig. 2. Line drawing as negative of result of the show-experiment Nieke [70]. In a schlieren apparatus by Abbe light is focused to a disk diaphragm. In the focal distance is standing an objective which is illuminating with parallel optical path the diffraction-slit. This slit is imaged with a second objective but in its image-side focus is standing the schlieren diaphragm which catches unbent light. The size of schlieren diaphragm can be chosen that the zeroth order of diffraction figure of slit is caught at that place. Only diffracted light gives image of slit.

a: Image of the slit in incident light.
b: Image of the slit in a schlieren apparatus.
The image of slit consists of double stripes which are divided by a thin dark stripe. One of double stripe lies shadow-side (!) and the other light-side of every slit-image.
c: In front of the imaging objective is masked one side of diffraction figure of slit.
d: The other side masked.
e: The schlieren diaphragm substituted through a disk diaphragm of same size, only the zeroth order produce the image. To that the illumination is to reduce in order to have no irradiation.

With knowledge of Newton's diffraction experiments this result is not astonishing. The breadth of the double stripe is dependent from aperture of imaging optic and measured < 0.1 mm For Newton observed sidewards so he could only see one part of the double stripe and with 0.03 mm his result is in good agreement. Nieke [70] could attach with detailer masking every order of diffraction figure two spheres in the image of slit. It is to notice that in the schlieren apparatus you will find the attaching of diffraction figure to the image of slit and not the assignment to sphere in the slit. The dark stripe in the double stripe at image of slit will be interpreted as trace of shadow side displaced light.

6. Interpretation of experiments: The photon with structure and field

By Kuhn [71] it is not enough that experiments are known which falsify an acknowledged theory, but it is necessary to know a new paradigm which explain the phenomenon altogether new. Now that is possible for since about the year 1960 is known that elementary particles have a structure. Here is to mention the name of Hofstadter [72]. Einstein could not use a structure for he died already 1955.

Heisenberg [73] gave as structure of photon side by side lying fermion and antifermion with spin and antispin as isospin.

Nieke [74] showed that Sommerfeld had unconsciously shown that the Schrödinger equation can be a formula of vortex dynamics. Sommerfeld [75] wrote (translated): „It is a very peculiar dynamics, we have here got known. It departed in decided points from the dynamics of mass-points. Already the lex prima of Newton is altered here. The isolated, therefore force free, vortex persists in state of rest. To a uniform rectilinear movement it is only able in union with a vortex of equal momentum and opposite sense of rotation, or under influence of a wall. ... Still more remarkable is the difference to lex secunda. The outer influence, which goes out of a second vortex, determines not the acceleration but the velocity. Therefore is also shifted the statement of sentence of centre of gravity: Not the acceleration of centre of gravity is zero but the velocity of centre of gravity".
Sommerfeld [76] could write the classic wave-equation and the Schrödinger-equation so that they, without the factor h and i, only differ that the classical wave equation contains the second derivation of ψ to time and the Schrödinger-wave-equation the first derivation to time as in vortex dynamics. This is a confirmation of Einstein, who demanded a 'system-totality' as solution of Schrödinger-equation. Nieke [74] concluded from them that the spin is to regard as rotation (of field) and not as a formal spin-quantum number. Therewith exists in harmonize with Heisenberg for a photon the structure of a vortex-pair. That are two vortices of equal vorticity but opposite sense of rotation which are in rest unstable and move with constant velocity perpendicular to the line between both centre of gravity.

According Dirac [77] every photon interfered with itself, and by Broglie a. Silva [78] served the wave as guidance-field for the photon. Here is to replace wave through field for light has an electromagnetic field, and so every photon has to have an electromagnetic field. By Maxwell every variable field has to be a vortex field so the field of every photon has to return to its photon.

Out of that Nieke [74] formed a model for the diffraction with photons with electromagnetic structure and field. From the photon runningly go out, above all towards in front, an electromagnetic field, which normally returns to its photon (new formulation of a Huygens' principle). Is the field asymmetrically hindered in returning, about by a slit or edge, so has the former vortex pair no more the structure of vortex pair but that of two vortices with opposite sense of rotation with a little different vorticity. Such an aggregate executes by Sommerfeld [75] a swinging around the common centre of gravity which is lying outside the line between the two centre of gravity (new formation of a interference principle). Therewith was given a mechanism for diffraction of photons as deflection which makes complete superfluous light as waves

Nieke [74] discussed the transition of inner to outer fringes at triangular-slit by Newton [3] fig. 1 with the photon with structure and field in the following manner: Inner fringes of the slit appear if the photons have only information of the near edge for only field is returned to the photon which has passed the neighbouring edge. In the sphere of outer fringes the photons with structure and field have the information of the whole slit for in the meantime field is returned which has passed the whole slit. But the bent photons yet only come out of the near surroundings of the edges as is shown in fig. 2. Newton [3] inferred rightly: Light runs here eel-like.

Newton and Young had observed rightly. In a schlieren-apparatus is unequivocally to decide that indeed bent light seems to come partly from the slit-jaws, this light has to be displaced shadow-side, the other part of bent light comes light- side near the edge. Be- tween both spheres appear a small dark strip which is to interpret as trace of shadow-side displaced bent light.

Also Huygens' principle has his authorization if it is modernized and completed: Every photon emits running an electromagnetic field which has normally to return to its photon. An asymmetric returning field causes diffraction as change of direction according to vortex-dynamics as interaction of a photon with vortex-structure with its field.

The extrapolation of formula (1) is doubtless inadmissible and wrong, but in large distances reaches field, which has passed the whole slit, its photon. On the contrary in short distances only field reaches its photon which passes near the edge and so it causes the diffraction-figure of the near edge.

The structure of photons makes possible to explain (preliminary qualitatively) all qualities of light, which former are believed to describe only as wave nature of light.

Therefore Einstein [79] was right! - a fusion of wave and particle is possible.

7. Einstein and the Copenhagen-interpretation of quantum-theory.

7.1. Einstein and Newton's diffraction experiments.

Out of the preceding sections is evident that Newton had not only asserted but proved, least with our present knowledge, that light never can be a wave (observation 10 with the transition inner to outer diffraction-fringes). Then with observation 5 (the proof of localization of bent light) Newton refuted indeterminism in diffraction. Therefore with his diffraction experiments Newton had refuted the Copenhagen interpretation which was built on dualism of wave and particle and indeterminism at quantum processes.

Einstein [79] demanded instead of dualism a fusion of wave and particle, and he opposed indeterminism ('God does not disc'). Therefore is the question: Why Einstein did not see the possibility of argumentation of his opinion in Newton's diffraction experiments? Out of text- or hand-books in his time he could not got the least hint, for off about 1850 nowhere this is reported. One could suppose that Einstein do not know Newton's diffraction experiments. But in 1934 Einstein [80] wrote a foreword to a reprint of Newton's optics. Therefore he had not seen the importance of Newton's diffraction experiments, presumable he had only run over the pages of the third book of optics. Indeed, Newton had not accented these experiments for he could not foresee that Fresnel simple extrapolated away these experiments, also Newton evaluated scarcely his diffraction experiments for nature of light. For true he would carry on these experiments, but known he was appointed to director of mint. Einstein had to experiment for judge more distrustfully Fresnel's diffraction experiments.

But Einstein could not offer an alternative, for with light-particles, light-quanta, or photons as mass-points diffraction indeed can not be established, for Newton's mechanics do not gave a possibility. That was the chance of wave, for water waves show sideways deflections. For in live-time of Einstein no structure of elementary particle were thinkable, so existed for Einstein no possibility to give an alternative for his disapproving opinion.

7.2. Einstein's papers

Einstein [81] began his first paper about quantum theory in the year 1905 (translated): „There exists a radical formal difference between the theoretical concept which physicists have formed about gases or other ponderable bodies and the electromagnetic processes by Maxwell's theory in the so called vacant room.“ As well the energy in ponderable bodies, the atoms, and electrons is not divisible, but according the undulation theory of Maxwell's theory, light has to be devisable as pleasure. He inferred from Planck's law of radiation and from presented papers of photoelectric effects the existence of quanta of light.

Einstein published in 1905 three fundamental and famous papers. The first [81] about quantum theory, the second [82] about heat, and the third [83] formed the basis of theory of relativity. For Einstein all three papers hung closely together with the origin, structure and motion of light.
Till 1923 Einstein advocated nearly alone seriously the quantum physics. After 1923 (discovery of the Compton effect) further he advocated nearly alone seriously quantum physics against dilution by dualism of wave and particle and the statistical interpretation. Einstein was standing always alone and solitary on the wide field what he complained repeatedly.

Born [84] denoted as Einstein's empirical creed (translated): „Conceptions which have shown usefully by putting things in order, obtain over us easily such an authority that we forget their earthy origin and take it as unalterable matter or fact. They turn then to 'necessity of thought' or 'facts a priori'. By such errors the way of scientific process is often made impassable for a long time.“

7.3. Dualism of wave and particle or complementarity

Einstein [85] wrote (translated): „It is not to astonish that Newton did not like to know something of undulation theory of light for this theory suited badly to his theoretical foundation. ... The strongest empirical arguments for the wave nature of light, definite velocities of propagation, interference, diffraction, polarisation, did not lay before respectably not easily to survey, so that he had a good right to hold fast at his theory of emission.“ This remark is so only possible that Einstein obviously did not respected Newton's diffraction experiments, else he had himself declared determinately for Newton and the emission theory.

Bohr [86] wrote (translated): „However, the hypothesis of quanta of light can be considered by no means as a satisfactory solution, for hitherto on this way we were not able not only to explain the phenomenon of interference, which where nevertheless our main means for examination considerations of radiation; but more over it excluded even on principle the picture, which is taken as basis of hypothesis of quanta of light, with possibility of a faithful definition of swinging number ν, which indeed performs in this theory a main point.“

This is the sole argument brought forward for dualism or complementarity: „Diffraction and interference are to explain with and only with waves.“
Already Mach [32] showed that all diffraction and interference experiments do not prove the wave but only the periodicity of light. The conception of wave is formulated always much too wide. Least it is to distinguish between physical wave, at which a drag force is present, and mathematical or formal waves without it. The 'sound wave' bases on impact processes, where eccentric collisions counterfeits Huygens' principle. Schrödinger [87] offered an impact processes for the Compton effect.

7.4. Exclusive probability or statistical interpretation

Einstein [88] wrote (translated): „But now I ask: believe true any physicist that we can never reach an insight in these considerable change of particular systems, their structure, and causal connection, nevertheless that particular occurrences thanks the wonderful invention of Wilson's chamber and Geiger's counter moved in such a nearness of experience? No doubt, to believe this is possible logical free of contradiction, but it resists my scientific instinct so lively that I can not omit to seek for a complete manner of interpretation.“ As cause of these incompleteness and with it the statistical state Einstein [89] wrote (translated): „The ψ - function describes not at all one state which

could belong to one single system; it relates rather to so many systems, a 'system-totality' in the sense of statistical mechanics If the ψ-function, apart from particular cases, yields only statistical statements about measurable quantities, so this is conditioned not only that the process of measurement introduced unknown, only statistical cacheable elements, but just that the ψ-function general does not describe the state of a single system. The Schrödinger-equation determines the temporal change which experience the system-totality, be it without, be it with outer influence, on the single system."
Einstein [90] gave the opinion to the objections of his highly estimated colleagues Born, Pauli, Heitler, Bohr, Morgenau (translated): „I will quote following arguments which detain myself to follow this opinion of nearly all contemporal theoretical physicists. Even I am firmly convinced that the fundamental statistical character of the present quantum theory is simple to ascribe the circumstances, that these operate with an incomplete description of the physical systems." Einstein [91] (translated): „ ... but the ψ-function is as description not that of one single system but it is to interpret as a system-totality. Rough expressed run this result: in frame of statistical interpretation there are no complete description of the single systems. Cautiously is to say so: The attempt to interpret the quantum theoretical description of individual systems leads to unnatural theoretical interpretations, which will be at once unnecessary, if the interpretation is accepted that the description related on the system-totality and not on a single system. Then becomes abundant the whole egg-dance to avoid the 'physical-reality'. However, it yields a simple psychological cause for that why this obvious interpretation is avoided. Namely if the statistical quantum theory pretends to describe the single system (and its temporal running) not completely, then it appears inevitably to seek another way for a complete description of a single system. At which it should evident from the start that the elements of such description does not lie within the scheme of concept of statistical quantum theory. With it would be confessed that this scheme in principle can not serve as basis of theoretical physics. The statistical quantum theory would - in case of success of such endeavours - in frame of the future physics take in a rather analogous position as statistical mechanics in the frame of classical mechanics. I am firmly convinced that the development of theoretical physics will be of such kind, but the way will be protracted and onerous."

7.5. Discontinuity - individuality- quantum-jumping

Bohr [92] emphasised the discontinuity or rather individuality as property of atomic processes. Heitler [93] wrote (translated): „It may be that jumps are caused by some external influences and then the time of their appearance can be predicated exactly. ... Further from the beginning it was accepted that the time, which the atom spends in the higher state, was not a fixed definite interval Δt which is the same for all atoms in equal state of stimulation, but that the life-time of the single atoms were statistical spreaded and obeyed a law of probability. ... Some physicists hoped also that such a process would succeed to themselves. The farsighted under them recognized the profound changes which signify the existence of such jumps for the classical interpretation, and nobody was more sensitive for such insight as Einstein itself."

The decidest opponent of quantum jumping was Schrödinger. By [94] he replayed while Bohr explained to him that even Planck's law could not be understand without the quantum-jumps: „If we are going to stick to this damned quantum-jumping, then I regret that I ever had anything to do with quantum-theory." That the quantum-jump is unjustified was already shown. A photon with structure can be built up in the so called life-time (in visible light $\approx 10^6$ periods). By Nieke [55] determined the part of thermal energy the statistic but deterministic process. Schrödinger could only suspect this but not prove.

The representatives of the Copenhagen interpretation are very sure that their theoretical building had a continuance for ever. So wrote Jordan [95] (translated): „The history of physics is not only a history of success but also a history of errors." For examples of errors he termed Einstein's holding-fast at causality and Schrödinger who would make dispensable through his equation the whole quantum jumping. Here Jordan had termed even examples which show that also Jordan and Bohr could go astray, as is shown in section 5 and 6.

The Copenhagen interpretation is distinguished through the convenience which it yield to their believers. The dualism permits a change to 'wave' which, identificated with an e-function with complex exponent, permits to exhibit with the Fourier theorem mathematical formal every piecemeal monotone function, therefore every experimental result. Then the statistical interpretation keeps off from the trouble, of penetrate the physical process more detailed for there are possible on principle

only probability statements in quantum processes. With them in the beginning there were possible indeed good successes for mathematical formulations, but already Broglie [96] wrote (translated): „Rather one should avoid the danger that a too fixed belief in statistical character this final will make sterile.“ This state took place already.
According to Heisenberg [97] there were three groups of opponents to the Copenhagen interpretation. 1st: Acknowledging of Copenhagen interpretation but attach to another philosophy. 2nd: Attempt to change the quantum theory in critical points and with it to reach the same results. 3rd: Refusal and general discontent without of counter-arguments as Einstein and Schrödinger.

Einstein's refusal of Copenhagen interpretation was reduced on an instinctive feeling that such can not be existing in the nature or more on philosophical-religious aspects.

Einstein [98] wrote (translated): „The whole fifty years conscious musing have brought myself not nearer to the answer of the question 'what are quanta of light'.“ Einstein [99] wrote (translated): „The quantum mechanics is very respectful. But an inner voice says to me that this is still not the real Simon Pure. The theory yields many but the secret of God brings it us scarcely nearer. In any case I am convinced that he does not dice." Pais [100] explained the vision of Einstein (translated): „He demanded that the theory has to be strict causal . . . and the postulate of quantum have to be a consequence of general field equations." So also Klein [101] put out that it was Einstein's aim to find a field theory which includes electromagnetism and gravitation with including the sources of field in a non-singular manner.

7.6. Voices of criticism after Einstein

The Copenhagen interpretation carried through in the time after the world-war II, in text-books were to find only Heisenberg-Bohr’s quantum-theory without critical remarks. It was the same situation as after 1850 was brought only Fresnel's theory and concealed Newton's diffraction experiments. Indeed, Einstein was not so completely concealed as then Newton's diffraction experiments, in historical considerations is to find Einstein's conception, but not Newton's diffraction experiments.

But also in this time are to find critical voices. Landé [102] refused the wave-interpretation of diffraction and tried to explain this with the quantum-condition by Duane [103] which demand an impulse perpendicular to propagation-direction proportional to h/Fourier-component of space-structure of bending-object. Then is to name Bohm [104], who demanded determinism and sharing of wave-functions.
A detailed list of literature of relation of quantum-theory and information gave Wheeler [105], Schweber [106] analysed the crisis of theoretical physics. These sought the origin by Bohr or later, by this paper the search for origin of the crisis has to begin already by Newton and Fresnel.

7.7. Additional considerations

Interrogations of diffraction or coherence are most mathematically formulated by Fourier-analysis at which are quoted also quantum-field-theory or quantum-electro-dynamics. Feynman [107] wrote in a popular scientific (otherwise such foundations are expressed not so distinct and quotable) introduction into quantum-electro-dynamics (QED) (retranslated): „No, you will not understand it. ... also my physic-students do not understand it. ... indeed because I do not understand it. Nobody comprehended it.“ „... deprive the kind and manner as nature compelled us to describe our understanding completely generally.“ „ ... that nature is reaching only in this manner." (This is with probability amplitudes).

Therefore this theory is formal mathematical and supported only by the Copenhagen-interpretation. Feynman established the excluding probability statements with the non-understanding of partial reflection with photons. But here the angle dependence of polarisation directs to a structure of photons, so that in future an explanation seems not so exclusive.

That light is only bent at every edge, of that Feynman knows obviously nothing (there fig 33 and 34). He emphasized explicitly that Newton was right with his theory of particles, but he meant that Newton's argumentation was wrong. Feynman certain did read not or only flightly Newton's diffraction experiments.

Detailed considerations for an alternative made Nieke [108].

Literature I.

[1] F. M. Grimaldi, Physico-mathesis de lumine, coloribus et iride. Bonniae 1665.
[2] C.Huygens, Teatise on Light. Macmillan, London 1912;.
Traité de la lumiére. Lipsiae 1805;
Abhandlungen über das Licht (1678). Ostwald's Klassiker Nr. 20. Engelmann, Leipzig 1890.
[3] Newton, Opticks, or a Treatise of the Reflexions, Refractions, Inflexions and Colours of Light. London 1704;
Qpera quae exstant ornnis. Tom IV. London 1782;
Optics. Reprint, Bruxelles 1966;
Optik II + III. Übers. W, Abendroth: Ostwald's Klassiker Nr 97 Engelmann, Leipzig 1898; Neuauflage Bd. 96/97, Vieweg, Braunschweig 1983.
Optique, Trac. J. P. Marat, 1787; Reproduction. Bourgois, Paris 1989.
[4] T. Young, A course of lecture on natural philosophy and mechanical arts. London 1807.
[5] A. J. Fresnel, Oeuvres Complétes I. Paris 1866;
Abhandlungen über die Beugung des Lichtes. Qstwalds Klassiker Nr. 215, Engelmann, Leipzig 1926.
[6] A. Kalaschnikov, J. Russ. Phys. Ges. **44** (1912), quoted by Laue [18] S. 332.
[7] Rubinowicz, Ann. Physik (IV) **53** (1917) 257 315.
[8] R. M. Shoucri, Optik **31** (1970) 315.
[9] F. Rosenberger, Isaac Newton und seine Prinzipien. Barth, Leipzig 1895, S. 300-1.
[10] M. v. Laue, Naturwissenschaften **15** (1927) 276.
[11] A. R. Hall, All Was Light, an introduction to Newton's Optics. Cla erendon Press, Oxford 1993.
[12] H. Nieke, Newtons Beugungsexperimente und ihre Weiterführung. Halle 1997, Comp. print 1. Arbeit 1.
(Vorhanden in vielen deutschen Universitätsbibliotheken)
Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 3, paper 1.
(Available in some university libraries)
[13] H. Nieke, Exp. Techn. Physik **31** (1983) 119.
[14] S. Ganci, Am. J. Phys. **20** (1989) 370
[15] C. Malange u. J. Gronkowski, phys. stat. sol. (a) **85** (1984) 389.
[16] As [12], paper 3.
[17] K. Schwarzschild, Math. Ann. **55** (1902) 177.
[18] A. v. Laue, In: Handbuch der Experimentalphysik Bd. 18. Akad. Verl. Ges., Leipzig 1928 S. 316.
[19] W.Arkadiew, Phys. Z. **14** (1913) 832.
[20] J.P. W. Herschel, On theTheoy of Light. 1828;
Vom Licht. Übers. J.E.E. Schmidt, Stuttgart u. Tübingen 1831, S. 335.
[21] J. B. Biot, Précis élémenthématique de physique expérimentale. Paris 1818-21.
Lehrbuch der Experimental-Physik oder Erfahrungs-Naturlehre. Übers. G.T. Fechner, Voß, Leipzig 1829 Bd. 5, S. 105.
[22] J. Z. Buchwald, J. Optics (Paris) **20** (1989) 109.
[23] J. Orear, Fundamental Physics. Wiley New York 1961;
Grundlagen der Physik. Hanser, München und Wien 1975, S. 314.
[24] Hiller a. E. Ramberg, J. Appl. Phys. **18** (1947) 48.
[25] H. Hönl, A. W. Maue u. K. Westphal, In: Handbuch der Physik Bd. XXII/1. Springer, Göttingen, Heidelberg, Berlin 1961.
[26] G. Kirchhoff, Vorlesungen über mathematische Optik. Teubner, Leipzig 1891.
[27] A. Sommerfeld, Vorlesungen über theoretische Physik Bd. IV, Optik. Dietrich, Wiesbaden 1950, S. 271.
[28] A. Rubinowicz, Ann. Physik (IV) **53** (1917) 257.
[29] A. Rubinowicz, In: Ed. E. Wolf: Progress in Optics, Vol. IV, North-Holland, Amsterdam 1965, S. 201.
[30] F. Kottler, Ann. Physik (IV) **70** (1923) 405; **71** (1923) 457.
[31] F. Kottler: In: Ed. E. Wolf: Progress in Optics, Vol. IV North-Holland, Amsterdam 1965, S. 233.
[32] E. Mach, Die Prinzipien der physikalischen Optik. Barth, Leipzig 1921;
The Principles of Physical Optics. New York 1926.
[33] M. E. Verdet, Ann. Sci. L'Ecole Norm. Super. (Paris) **2** (1865) 291.
[34] As [12], paper 4.
[35] E. Berge, Math. naturwiss. Unterricht **27** (1974) 326
[36] H. P. Cittert, Physica **1** (1934) 201.

[37] F. Zernicke, Physica **5** (1938) 785.
[38] S. I. Wawilow, Die Mikrostruktur des Lichtes. Akademie-Verl. Berlin 1954, S. 62, 76 u. 84.
[39] G. T. Reynolds, K. Spartalian a. D. B. Scarl, Nuovo chim. **61** B (1969) 355.
[40] P.A. M. Dirac. Die Prinzipien der Quantenmechanik. Hirzel, Leipzig 1930, S. 2.
The Principles of Quantum Mechanics. Clarendon Press, Oxford 1935, 1947, 1958, p. 9.
[41] As Newton [3], but book II.
[42] A. Michelson, Phil. Mag. **30** (1890) 1.
[43] F. Vinson, Optische Kohärenz. Akademie-Verlag, Pergamon-Press, Vieweg, Berlin, Oxford, Braunschweig, WTB Bd. 85 (1971).
[44] J. Perina, Coherence of Light. Norstrand, London, N. Y., Cincinnati, Toronto, Me1bourne 1971.
[45] R. E. Kinzly, J. Opt. Soc. Am. **55** (1965) 1002.
[46] P. S. Considine, J. Opt. Soc. Am. **56** (1966) 1001.
[47] B. J. Thomson, Ed. E. Wolf, Progress in Optics VII (1969) 170.
[48] H. Nieke, Exp. Techn. Physik **31** (1983) 53.
[49] Ch. Hofmann, Fortschr. Physik **27** (1979) 595; Exp. Techn Physik **28** (1980) 403.
[50] F. Zernicke, Physica **9** (1942) 686.
[51] F. T. 5. Yu, Ed. E. Wolf, Progress in Optics XXIII (1986) 222.
[52] K. Pietsch u. E. Menzel, Optik **49** (1977) 203.
[53] E. Menzel, W. Mirade u. I. Weingärtner, Fourieroptik und Holographie. Springer, Wien u. New York 1973, Zitat im Vorwort.
[54] B. Hanbury-Brown a. R. Q. Twiss, Proc. Roy. Soc. London **242** (1957) 300; **243** (1958) 291.
[55] As [12], paper 15.
[56] G. Magyar a. L. Mandel, Nature **198** (1963) 255.
[57] G. Richter, W. Brunner u. H. Paul, Ann. Physik (7) **14** (1964) 239
[58] P. L. Kapitza a. P. A. M. Dirac, Proc. Cambridge Phil. Soc. **28** (1933) 297.
[59] H. Schwarz, Z. Phys. **204** (1967) 276; Phys. Bl. **26** (1970) 436.
[60] R. H. Stuewer, Isis **61** (1970) 188-205.
[61] H. Arndt u. H Nieke, Z. Psychol. **193** (1985) 295.
[62] As [12], paper 5.
[63] As [12], paper 8.
[64] L. de Broglie, Die Elementarteilchen. Govarts, Hamburg 1943.
[65] M. Born, Physics in my Generation. Pegamon, London 1956; Akademie-Verlag, Berlin 1958.
[66] A. Smekal, Naturwiss. **11** (1923) 973.
[67] As [12], paper 6.
[68] E. Mach, Sitzungsber. Akad. Wiss. Wien, math.-naturwiss. Kl. Abt. II, **52** (1865) 302; **54** (1866) 131; **57** (1868) 11; **115** (1906) 635.
[69] H. Nieke, Exp. Techn. Physik **31** (1983) 53.
[70] As [12], paper 2.
[71] S. Kuhn, The structure of scicntific revolutions. Chicago 1962;
Die Struktur wissenschaftlicher Revolutionen.Suhrkamp, Frankfurt M 1973.
[72] R. Hofstadter, Rev. Mod. Phys. **28** (1956) 214, **30** (1958) 482; Phys. Bl. **18** (1962) 193.
[73] W. Heisenberg, Introduction to the Uniform Field Theory of Particles. New York 1966.
Einführung in die einheitliche Feldtheorie der Elementarteilchen. Hirzel, Stuttgart 1967. S. 116.
[74] As [12], paper 12.
[75] A.Sommerfeld, Vorlesungen über theoretische Physik, Bd. II, Mechanik der deformierbaren Medien. Akad. Verlagsges. Leipzig 1945, S. 155.
[76] A. Sommerfeld, Atombau und Spektrallinien. Bd. II. Vieweg, Braunschweig 1960.
Gleichungen (I.1.5) und (I.6.9a);
Atomic Structure and Spectrallines. Methuse, London, 1923, 1930, 1934.
[77] P. A. M. Dirac, Die Prinzipien der Quantenmechanik. Hirzel, Leipzig 1930.
The Principles of Quantum Mechanics. Clarendon Press, Oxford 1935, 1947, 1958, p. 9.
[78] L. de Broglie a. J. A. E. Silva, Phys. Rev. (2) **172** (1968) 1284.
[79] A. Einstein, Phys. Z. **18** (1917) 121.
[80] As [3] Reprint from the fourth edition 1730 (with a Foreword by Albert Einstein and an Introduction by Sir E. T. Wittaker) 1934.
[81] A. Einstein, (Über einen die Erzeugung und Verwandlung des Lichtes betreffenden heuristischen Gesichtspunkt) Ann. Physik (IV) **17** (1905) 132-148.
[82] A. Einstein, (Über die von der molekularkinetischen Theorie der Wärme geforderten Bewegung von in ruhenden Flüssigkeiten suspendierten Teilchen) Ann. Physik (IV) **17** (1905) 549-560.
[83] A. Einstein, (Zur Elektrodynamik bewegter Körper) Ann. Physik (IV) **17** (1905) 891-912.
[84] A. Schlipp (Ed.): Albert Einstein, Philosopher - Scientist. Evaston (USA) 1949 and 1951.

A. Schlipp (Hrsg.): Albert Einstein als Philosoph und Naturforscher. Kohlhammer, Stuttgart 1956. N. Born: Einsteins statistische Theorien. Zitat S. 96 bezieht sich auf A. Einstein, Phys. Z. **17** (1916) 101.
[85] A. Einstein, Qut of my later years. Phil. Lib. New York 1950.
Aus meinen späten Jahren. D. Verl. Anst. Stuttgart 1979 (2. Aufl.) S. 109.
[86] N. Bohr, Z. Phys. **13** 1923) 117, quotation S. 157.
[87] Schrödinger, Über den Indeterminismus in der Physik. Barth, Leipzig 1932, S. 15.
[88] A Einstein, As [85], S. 99-100.
[89] A.Einstein, As [85], S. 97-98.
[90] A.Einstein, As [84], Zitat S. 493-494.
[91] A.Einstein, As [84], S. 498.
[92] N. Bohr, Atomtheorie und Naturbeschreibung. Springer, Berlin 1931, S. 35;
Atomic Theory and the Description of Nature. Univ. Press Cambridge 1949
[93] W. Heitler, In [84], S. 98-114, quotation S. 100
[94] W. Heisenberg, In: W. Pauli (Ed.): Niels Bohr - and the development of physics. Pergamon, London 1955, S. 12-29, Quotation p. 14.
[95] P. Jordan, Albert Einstein - Sein Lebenswerk und die Zukunft der Physik. Huber, Fraunfeld u. Stuttgart 1969, S. 49.
[96] L. de Broglie, La Physique quantique restera-t-elle indéterministe? Gauthier-Villars, Paris 1953
Phys. Bl. **9** (1953) 488-497 u. 541-548
[97] W. Heisenberg, Physics and Philosophy. Harper & Brothers York 1958.
Physik und Philosophie. Hirzel,Stuttgart 1972, S. 119.
[98] In: A. Pais, „Raffiniert ist der Herrgott ... .“ Albert Einstein - eine wissenschaftliche Biographie. Vieweg, Braunschweig/Wiesbaden, 1986, S. 389
‘Subtile is the Lord ...’ The Science and Life of A. Einstein. Claendon, Oxford 1982.
[99] In: M. Born, The Born-Einstein Letters. Walker, New York 1971. Albert Einstein - Hedwig und Max Born - Briefwechsel. Nymphenburger, München 1969, S. 96.
[100] As [99], S.473
[101] A. P. French (Ed.), Einstein - A Century Volume. Heinemann 1979
A. P. French (Hrsg.): Albert Einstein - Wirkung und Nachwirkung. Vieweg, Braunschweig/Wiesbaden 1985
Hier in: M. J. Klein: Einstein und die Entwicklung der Quantenphysik. S. 227-252.
[102] A. Landé, Ann. Physik (7) **33** (1976) 88.
[103] W. Duane, Proc. Nat. Sci. Wash. **9** (1923) 158.
[104] D. Bohm, Phys. Rev. **85** (1952) 166; **87** (1952) 389);
Ref.: D. A. Albert, Spektr. Wiss. Juli 1994, 70.
[105] J. W. Wheeler, In: Proc. 3rd Int. Symp. Foundations of Quantum Mechanics, Tokyo, 1989, p. 354-368.
[106] S. S. Schweber, Physics Today, Nov. 1993, 34.
[107] R. F. Feynman, QED - The strange theory of light and matter. Princton Univ. Press, Princeton 1985;
QED - Die seltsame Theorie des Lichtes und der Materie. Piper, München, Zürich 1985, S. 20, 92, 93.
[108] As [12], paper 20.

II. Philosophical Consequences out of Newton's Diffraction Experiments

Index Page

1. The dualism of wave and particle at diffraction

Wave and particle are physically two so different things that they exclude another. One and the same thing as light can be impossible as well a wave as a particle. This is acknowledged everywhere. In the beginning of our century the quality of light as wave seemed so secured as light as particle. So yielded a problem what did not be physically solvable. The philosophy keep ready for

such problems the idea in the form of dualism of body and sprite. It was near to hand to offer the dualism of wave and particle as philosophical solution.

1.1. Arguments to dualism of wave and particle

1st group: As probability and complementarity

The wave resp. the quantity $|\psi|^2$ is considered as probability to meet a particle in an element of volume. As discoverer of this interpretation is named Born [1]. Also Bohr [2] applied this conception but he far extended dualism of wave and particle as complementarity double-face of reality. He wrote for conception of complementarity as general law of nature (translated): „On contrary in quantum physics the won experiments with help of different experimental arrangements are standing to each other in a novel complementary relation. Indeed, it must recognized that such experiences which appear contradict each other, if it is tried to draw they together in one picture, exhaust all about the object cacheable knowledges." And: „these circumstances find their quantitative expression in Heisenberg's uncertainty relations concerning the mutual free-scope in quantum mechanics for fixing of cinematic and dynamic variables ..."

Today this is the most advocated opinion which Bavink [3] formulated (translated): „All of them is to say that the new quantum mechanics resp. wave mechanics do justice nearly in most cases the today known matter of facts, ..., so that no physicist, who knows the condition more accurate, at that thinks to refuse it - perhaps because of their nearly total inevidence ...: it is not to expect that nature does us the favour to be complete cacheable unconditionally with the simplest conceptional resource of habitual perception of sense."

The here advocated dualism of wave and particle or complementarity and additional the indeterminism, which will be considered in the next section, is denoted as Copenhagen interpretation. Weizsäcker [4] tried to unite the opinion of group 1 and 2.

2nd group: As insufficiency of our speech

Heisenberg [5] wrote (translated): „Light and matter are uniform physical phenomenons, their apparent double-nature lies in the essential insufficiency of our speech." He established the failure of speech in description of atomic processes that their conceptions of our speech traced back to the experiences in daily life, at that we consider never single atoms. We have no perception for atomic processes. He continued: „For the mathematical order such a perception is not at all fortunately necessary; we possess a mathematical scheme of quantum theory that does justice all experiments of atom physics." His argumentation established that spatial and temporal behaviour, with the to that belonging uncertainties, has to be describable in a wave picture, at which the description ensues as wave packet. He formulated this so: „A universal mathematical sentence says that by suitable combination of single partial waves it is always possible to build up a wave packet of any form." Therewith he means the Fourier-theorem which permits to exhibit all piecemeal monotone functions. Heisenberg [6] tried a proof for a formal mathematical equivalent of quantum theory with wave picture and that of particle picture, while he showed that both bring the same results in mathematical developments in series. Else his arguments flow into the group 1 at which he self directed.

Therefore he appointed to the Fourier-theorem, which allowed to exhibit all picewise monotonous functions and therefore all experimental results are so exhibitable.

3rd group: Simple as fact

The interpretation of special experiments by waves - and others by particle is suffered as fact. Foundations or reasons are not named. This exhibitions are to find frequently in newer text books of physics. As example shall quoted Feynman [7] (translated): „Newton thought that light consists of particles, yet then was discovered that light behaved as a wave. However, later was found that indeed sometimes light behaved as a particle. ... In reality it behaves neither as the one nor as the other. Give we up. We say: It is as neither of both."

4th group: As model which explains nothing

As typical example here is quoted Westphal [8] (translated): „It signifies an extraordinary cognition-theoretical progress that final was comprehended the complete unobjectionation of this dualism of wave and particle. It is therefore unobjectionable because the model presentations 'declare' nothing, because light 'is' neither a wave nor a particle, but something what is inaccessible to a obvious description."

5th group: As example of negation of negation

Hörz [9] submitted a pure philosophical interpretation with the dialectical negation of negation (translated): „... So was negated Newton's particle conception of light in the theory of wave and as negation of negation reached the quantum mechanics. However, it is not a pure theory of particle but respected the wave qualities of light too."

6th group: As preliminary fact with hope on better understanding

Sommerfeld [10] is quoted as a typical example (translated): „The light has a double nature; ... both are enjoyed equal rights, as we can see today, both together first give completely their nature. Therefore we speak better not of duality of light but of a by Bohr stamped term of its complementarity. ... It is clear that this comple- mentarity overthrow all scholastic ontology. What is truth? We ask this Pilatus-question not in a sceptic, science-hostile sense, but in the confidence that further work-through of the new situation will lead to a profounder understanding of physical and psychical world." Similar completed PohI [11]: „The dualism is certain unsatisfactory, ... A transfer of wave presentation on the vacuum is already a far extending abstraction." To this group belonged also Hund [12] who wrote (translated): „However, the foundation of quantum theory on the dualism of wave and particle is a prejudiced standpoint, and one should remain consciousd of this." Laue [13] wrote: (translated): „As wave mechanics is to conceive, remains completely dark by conviction of the author." And: „ ... For the author shines no smaller the difficulties to unit jointly particle and wave-conceptions for the same object. ... One do not say this difficulty were invincible on principle. In an interpretation of every experiment is involved already theory."

7th group: As particle with guidance-wave

As is well known, Broglie provided essentially the introduction of dualism of wave and particle by his prediction that also other particles as light-quanta have wave qualities as dualism. For Broglie [14] held fast at causality, as in the second section will be reported, he supposed after a phase of transition hidden parameter. A guidance- or pilot-wave should lead the photon corresponding the probability of meeting a photon. As background of this appearance Broglie [15] supposed the method of double solution where the solution u as singularity describes the particle and ψ the wave. Thus Broglie changed from a philosophical to a physical-mathematical solution. This view advocated also Bohm [16] with wave as quantum-potential. But already Born [17] corrected guidance-wave in the general physical form: guidance-field.

8th group: Consequent refuse of dualism

The prominentest representative of this group was Einstein [18] who demanded a fusion of wave and particle. He wrote 1928 in a letter [19] to Schrödinger (translated): „Heisenberg-Bohr's reassurance-philosophy - or religion? - is so finely concocted that it delivers to the believer in the meantime a soft resting pillow of that he is not so easily to scare." Einstein wrote to Born [20] 1936 (translated): „...Always still I do not believe in finality of statistical method of quantum theory, but I am standing with my opinion preliminary alone on the wide field!"

By Schrödinger [21] there is no dualism for he regarded only the wave as reality, the particle was for him a wave packet. With this view he stood alone at that time. Landé [22] refused the dualism, the space structure of diffraction-object should involve the diffraction figure. By Pauli [23] divide the opposition against primary probability in two classes (translated): „The one (to it belongs Schrödinger) find wave better than particle. ... The others like to introduce the old Broglie's theory of 'pilot-wave' ... for the so in two parts divided physical reality." Einstein's demand of fusion, he did not mentioned.

Particulars of the discussion between Einstein and Bohr are described by Jammer [24], Bunge [25] and Röseberg [26]. On the contrary Kaschluhn [27] did not be righteous to Einstein if he wrote (translated): „It belongs doubtless to the tragic sides of Einstein's life that the further development of quantum theory led to a turning-away from his physical base-introduction, to a turning-away from which is to suppose that it is final."

Today preponderant Bohr is regarded as victor of this discussion between Einstein and Bohr, to injustice as is shown in this paper.

1.2. Newton's diffraction experiments

A survey of this field is given in part I of this paper and by Nieke [28]. Here are reported only the most essential in catchwords.

Everyone, who had heard anything about optics, knows that Newton had asserted that light is consisting of particles of light. That he was right with this, we know since the beginning of our century as was proved the structure of quanta of light.

By extrapolation of the formula for diffraction at slit (part I, formula 1) to the distance nought or to the slit-plane was concluded that the slit limits a wave-front and every point of this wave-front will be an origin of a new spherical-wave. This extrapolation is inadmissible for in short distances originate the inner diffraction-fringes. This extrapolation is wrong too for bent light comes only out of the narrow surroundings of every edge and not from the whole slit.

But Newton and his follower could explain convincingly with "fits" (= real fits and no caprices) neither the interference appearances nor Newton's diffraction experiments with punktiform light particles. According this paper indeed something was missing: the structure of light-particle and their field. However, at that time this was not foreseeable.

In part I Heisenberg's model of the photon was combined with conceptions of Broglie, Dirac and Sommerfeld's unconscious proof of the possibility of Schrödinger-equation to be a formula of vortex-dynamics. This leads to the structure of photon as an electromagnetic vortex-pair with a returning field. If the returning field is hindered, so is qualitatively to establish with vortex-dynamics diffraction as deflection of direction.

So besides experimental proofs lie before an alternative for Einstein's refusal opinion to dualism of wave and particle; an alternative which fulfil Einstein's [18] demand for fusion of wave and particle. So has by this paper the group 8 the best arguments.

1.3. Estimation of arguments to dualism of wave and particle

The groups 1 and 4 are stamped positivistic for the question for cause is consciously not asked. That this mentality more confused as served, was established often (e. g. Planck [29]), here is an example where positivism appeared as reassurance-philosophy. Einstein [30] denoted explicitly Born's opinion as positivistic. But by Vogel [31] Born is not general to classify as positivist. To the Copenhagen school was reproached also idealistic elements what was contested by them. If one hold fast in (their) known physical facts (and if one do not take amiss their ignorance of Newton's diffraction experiments) or mathematical inferences as the Copenhagen school, so it is difficult or impossible to distinguish between idealistic or materialistic supplements. Differently are the things in the demand of the Copenhagen school for the indeterminism, but this is discussed in the next section.

The group 2 has no philosophical motive. At that time the possibility of physical establishments conditioned the missing of conceptions and so the speech was insufficient. With the formal proof of mathematical equivalence in development in series of wave- and particle-picture Heisenberg [5] tried a mathematical fusion but Einstein demanded a physical fusion. Heisenberg did not believe to fear a refutation for the Fourier-theorem guaranteed to calculate every experimental result. Formal mathematics should compensate the missing physics.

The group 3 is to mark as pragmatic. So Heisenberg [32] reported that he was astonished and together frightened by the pragmatism how American physicists reacted on his in 1929 in USA delivered discourses.

Group 5. The dialectic negation of negation was introduced by Hegel. Hegel [33] wrote about light (translated): „As the abstract self of matter light is the absolute lighting, and as matter the infinite outer selfing; but as pure manifesting, material ideality it is an inseparable simple outer self being." That is a scarcely not to excel speculative dialectic. Marx [34] wrote (translated): „It (Hegel's dialectic) is by him standing on the head. It has to be overturned to discover the rational kernel in the mystical covering." Hörz [35] remarked to this (translated): „The third hitherto scarcely examined law, that of negation of negation, determined the direction of development." Also the here considered refusing shows that this principle is unfit for natural science and makes possible fictitious reasons, here do not help 'principal-negation-directions'.

Group 6. Representatives of this group tried to remain neutral. But they applied pragmatically the Copenhagen interpretation and provided so for spreading, whereas their critical state did not precedented as a model.

Group 7. Doubtless Broglie initially provided for spreading the idea of dualism of wave and particle. But with the hidden parameters he advocated a physical or materialistic idea, for this declare that here are still missing knowledges. True, Broglie approached near the induction of Einstein's fusion of wave and particle.

Group 8. Einstein was right, for the demand of fusion of quality of wave and particle was thoroughly possible. Heisenberg [36] wrote to Einstein's objections to Copenhagen interpretation (translated): „It is easily to see that this criticism demand only again the old materialistic ontology." This estimation is

right, as particularly is shown by Sommerfeld's unconscious proof. But Heisenberg meant more with it, he demanded the explanation of formation of quanta. But that is yet now not succeeded, but there is exhibited a new way. Certain is: the dualism of wave and particle is to substitute by interaction of photons with structure and their field.

1.4. Inferences

In the newer literature, so in all text-books too, the dualism of wave and particle is exhibited as experimental completely certain by missing of counter-experiment. (Newton's diffraction experiments are concealed!) Therefore from this influenced physicists held that as so certain as the impossibility of perpetuum mobile, and therefore it appeared senseless to search here further. That had fateful consequences for so all search was repressed. So the philosophical interpretation of dualism of wave and particle had kept over decades.

After 1960 a structure of elementary particle were discussed and first then this problem could be worked new. The decision of a physical argument for mechanism of diffraction with photons by change of direction gave part I.section 6. with the mechanism of turning of photons with vortex-structure and field. Only there for light-particles or photons as mass-points without structure could be declared no physical cause for diffraction, only therefore light as wave could be introduced and endured so long.

2. The determinism at diffraction

2.1. General

Causality (causa <lat> - motive, cause) signifies that to every cause belongs an effect. Determinism (determinare <lat> - mark off, delimit) is used for being stipulated and points to an interaction. Causality is partly put equal determinism, expediently there are defined differences. First here is to answer the question: Is the indeterminism valid in quantum physics where only probability statements are possible, or are possible over probability statements yet deterministic statements. Further is to discuss if Heisenberg's uncertainty relation means a fundamental limit, or only a measure technical bound. Final is to examine if interaction is to get not, only statistical mathematical, causal or deterministic.

2.2. Opinions to causality and determinism

1st group: Indeterminism

Follower of the excluded probability statements in quantum processes satisfy indeterminism or Heisenberg's uncertainty relation, in order to originate at repetition with the same arrangement the same probability distribution. The indeterminism was taken over in the Copenhagen interpretation. Bohr considered basing on complementarity and uncertainty relation that it is senseless to accept a determinism. Heisenberg's uncertainty relation will do for explain diffraction: A wave-front strikes a slit and then there are possible only probability statements. But Bohr [37] wrote (translated): „For we are united all with Newton that the true basis of science is existing in the conviction that nature exhibited under the same conditions always the same lawfulness." Bohr [37] wrote also (translated): „ ... Simultaneous this situation compels us to renounce on performance of a causal description of the phenomenon of light and to contend us with laws of probability, which based on the fact that electromagnetic description of transfer of energy by light remains valid in statistical sense. At such considerations we have it to do with typical application of the so called principle of correspondence that is an expression for our endeavour, at fitted limited use of mechanical and electromagnetical inductions, to get a statistical description of atomic phenomenons which exhibit themselves us a contradiction free generalization of classical physical theory, although the action-quantum is to consider as an irrationality from the standpoint of this theory." Thus Bohr considered, based on complementarity and uncertainty relation, that is it senseless to accept a determinism.

Born [38] demanded (translated): „If anyone will hold fast in the hope that determinism will return one day, so have one to hold for wrong the present existing theory with regard to its contains appointed statements of this theory have to be refutable experimentally. The determinist shall not be protesting but experimenting for convert the follower of statistical theory." In a former paper Born[39] was not

so absolute (translated): „... this indeterminism peculiarly accented for it seams for me in best agree with the praxis of the experimental physicist. But it is natural at liberty to every one, who will himself not quieten, to accept that there are further not in the theory introduced parameters, which determine the singular result."

2nd group: inderterminism with mathematical restrictions

Heisenberg [40] wrote (translated): „Final one could pursue only quantitatively the chain of cause and effect if the whole universe is included in the system - but then physics is disappeared and only a mathematical system remained. Therefore the division of world in the observed and to observe system prevents the causality. ... As example for special causal connection are mentioned however: The laws of preservation for energy and impulse are value rigorous in quantum theory too." And further: „General in quantum theory one can put up a sort of causality in the following form: If to some time certain physical quantities are measured so exact as principle possible, so are calculable to every time qualities exact in their value, i. e. for that the result is to foretell precisely, provided that the observed system is subjugated no other disturbance besides the named measurements."

Heisenberg made loose the indeterminism whilst he certain interaction considered as mathematical calculable.

3rd group: Indeterminism with philosophical restrictions

For example here is quoted Blochinzew [41]. He used full the mathematical apparatus of quantum theory, but marked the Copenhagen interpretation as positivistic and objected the deny of objective existence of matter. He accented the material bound of subject and object. Further he wrote (translated): „The statistic lawfulness considered independently from the measurement as a lawfulness of nature." „It should be wrong to suppose that one could (perhaps in future) the conception of the classical causality to employ in single micro appearances, as this is possible to an isolated system. It is rather more probably that such an isolation in the world of atomic appearances does exist not at all."

In a footnote Blochinzew considered a non statistic theory of micro appearance for possible if new physical appearances are found which we are able to day still not even to suppose. Similar Weizsäcker [42], who attended else the group 1, considered openly this possibility (translated): „ ... they will relate to experiences which we do not know or still not understand."

4th group: Causality as signpost for direction

By Planck [43] is to quote (translated): „The law of causality is neither right nor wrong, it is a heuristic principle, a signpost, and of my opinion the most valuable signpost we have, to find our way in the coloured confusion of events, and to indicate the direction in which scientific research has to lead the way for arriving fruitful results." By Kant [44] causality is not a pure sentence a priori but a law of experience and a law of reason.

5th group: Determinism

For the follower of determinism the same probability at repetition of an experiment is not thinkable without a causal or deterministic foundation, at quanta processes too.

The prominentest representative of this group was Einstein. He wrote to Born [45] (translated): „Bohr's opinion about radiation is very interesting to me. But to a renunciation of rigorous causality I do not like to let drive myself, before one has not defended against that completely otherwise as hitherto." But this defence ensued not by other physicists, but the majority favoured the Copenhagen interpretation and with it the indeterminism as more convenient solution. To Born he wrote 1953 (translated): „Probable the non dice-playing God had this so decided, which took to me as bitter amiss not only the quantum theoreticians but also the believers of the church of atheists." And: „I believe still on the possibility of a model of reality i. e. of a theory which exhibited the things self and not only the possibility of their appearance."

2.3. Heisenberg's uncertainty relation

By Heisenberg [46] and Nieke [47] results from Heisenberg's uncertainty relation with the formula (1) in part I (Heisenberg used the grating but this formula differs only in a factor 2) to slit equation (1) in part I of width d and uncertainty of locality Δx

$$\Delta x > d / m. \qquad (1)$$

It means that for the order m = 1 a determination of locality is impossible. With $h/2\pi$ in the uncertainty relation $\Delta x \, \Delta p_x = h / 2 \pi$ but further on the impulse of photons perpendicular to the direction of propagation $p = h / \lambda$ results

$$\Delta x > d / 4 \pi m . \qquad (2)$$

So an exactness of about d/12 were possible and for higher orders still more. This result could not be confirmed. The breadth of sphere from which bent light is coming or seams to come is not dependent on the width of slit. As limit of an attachment of spheres in the image of slit in a schlieren-apparatus is shown by Nieke [48] the sphere of one order, for masking outside a minimum appeared additional diffraction. Moreover, the used formula is not allowed to be extrapolated to the distance nought.

Nieke [48] showed that Heisenberg's uncertainty relation can not be valid for particles with structure when they do not run rectilinear, for these particles can not marked with two statements as locality and momentum or other conjugated variables. Therefore Heisenberg's uncertainty relation is not useful for particles with structure.

Einstein [49] acknowledged Heisenberg's uncertainty relation (for he did not noticed Newton's diffraction experiments) (translated): „They all (the authors of Schlipp's book) are firmly convinced that the riddle of double-nature of all particles (particle- and undulating-character) has found on principle a final solution through the statistical quantum theory. They see it as proved on base of successes of this theory that it is in sense of the theory a complete description of the system, on principle only statistical statements could involved relative to in this system measurable qualities. Indeed they all have the opinion that Heisenberg's uncertainty relation (their prove is considered with right as definitive of my opinion) prejudice the character of all thinkable reasonable physical theories on principle in the incident sense." Corresponding by Meyer-Apich [50] entered through Heisenberg's uncertainty relation with experiments statistics in the description of nature. Schrödinger [51] remarked that already always two locality - time measurements were necessary to measure a velocity; therefore already always the classic mechanics are indeterministic. For every measurement was and is bound with an error and this error propagate farther, so can not be spoken from a fundamental difference to exclusive probability.

Kant [44] asserted of 'the thing as such' which we never can comprehend completely. That had never lead to a limitation of intensity of research for it was possible to approach progress asymptotically. Differently Heisenberg's uncertainty relation in union with indeterminism or exclusive probability statements. Here is blocked up at a fixed limit: It is on principle senseless to ask further. Here the progress can be hindered.

In the last time this theme came in a new phase. In near-field-optics are reached resolutions (nano-structures), which should not be possible according Abbe's equation in microscopy or according to Heisenberg's uncertainty relation. Nieke [52] established: Abbe's equation and Heisenberg's relation were derived through the formula of diffraction at slit or grating by Fresnel. By Nieke diffraction takes place by change of direction as a result of interaction of photons with structure and their field. In origin or transformation the photon has its field to build up first or again. In this time the photon can not normally interfere for it has no field for it. So during this time the photon can not change its direction according above formula, near-field-optics is so short-time possible.

With it Abbe's equation for resolution and Heisenberg's relation for uncertainty were shown as not universally valid.

2.4. Estimation of arguments pro and contra determinism

In the last section is shown unequivocally that the indeterminism for diffraction is wrong in every case. But the limitation of accuracy on one order of attachment in diffraction figure to the slit-image referred in part I.5.6. showed, that it can not be generally spoken of causality at diffraction. All appearances point to a deterministic interaction which will be effective if the masking plane is placed outside the minimum of the diffraction figure. The order of diffraction is the limit for determination of locality in plane of slit image for with masking outside a minimum results additional diffractions at masking-plane.

Broglie [53], who, as he wrote of despair, had advocated a short time the these of probability, wrote (translated): „Rather one should go out of way the danger that a too fixed belief in statistical character of quantum theory makes this final sterile." Then he advocated the theory of hidden parameters (by Einstein 'ghost-fields'), i. e. he hold fast in causality or determinism, also if the occurrence was unknown.

Schrödinger [54] wrote (translated): „... pull down the barrier between observer and observian ..., what is for some a still more radical thoughtfully revolution, whereas I only see an overestimated provisory aspect without deeper signification."

The interaction as last reason of all things are to find already by Kant [55] (translated): „All substances, provided that they can be perceived together in the space, are in a general interaction." By Hegel [56] (translated): „The causality is here turned in a general interaction." Hörz [57] described this as dialectic determinism. Bunge [25] emphasized that in the debate Bohr-Einstein each had won a round. Bohr hold his theory with injustice for complete but the probabilities of his quantum theory have a permanent worth, but they do not exclude causality. Interesting is the opinion from Goethe [58] in the sense of interaction (translated): „The thinking person goes especially to astray if he inquired for cause and reaction: the both together makes the indivisible problem. Who know that to recognize is on the right way of doing, of action."

General all fundamental laws are fit for representation as interaction, as e. g. gravitation, electricity, magnetism, and collision processes. If in gravitation on the earth-surface the reaction to the earth is to neglect, so it is possible to speak of causality and for such applications this conception was developed. In quantum processes in no case such a neglecting is possible. So it was authorized by Born and Bohr to object against causality. However, this was no reason to accept indeterminism, but it was to go back to deterministic interaction. Broglie [59] designated this as weak causality. Interaction is mathematically to solve closely only at the two-body problem and there is presupposed as simplification the particles as mass-points. Now it is unconditional necessary to accept a structure for elementary particles with spin, charge, magnetic dipole-moment etc., so the two-body problem is to calculate closely only with neglects. But that is no reason to give up interaction as deterministic principle. So are chaotic processes marked as deterministic chaos.

2.5. The determinism at other quantum processes

Besides diffraction as arguments for indeterminism are quoted e. g. the excluding probability statements fore life-time in atomic emission processes and half-life-time at radioactive decay.

Nieke [48] interpreted life-time as the time for transformation the stimulation-energy as energy of oscillation into vortex-energy for building up to a photon. In this time the photon is in 'status nascendi'. So is already a stay during life-time e. g. by Georgi [60] interpreted as virtual photon. So is avoided the quantum-jumping which Schrödinger [61] attacked so vehemently.

If at radioactive decay process is succeeded to show that a special constellation of elements of building atom nucleus and atomic orbitals are authoritative for triggering the decay, so should with the probability of this constellation for the decay processes nevertheless be a deterministic process.

2.6. Determinism and hidden parameters

Here was shown that the determinism as interaction is superior the indeterminism. Baumann a. Sexl [62] described 'the (provisional) end of determinism' according the state of discussion of hidden parameters at that time. The proof of determinism already by Newton's diffraction experiments show hidden parameters are pretended by interaction.

3. The return to classical thinking

3.1. Historical basis

Schrödinger [63] considered the to him named equation for a return to classical thinking. Born [64] maenad to this (translated): „Schrödinger was least so obstinate as Einstein in his conservative opinion to the quantum mechanics, indeed he rejected not only the statistical interpretation but he insisted upon that his wave mechanics means the return to classical thinking."

The discovery of quantum experiences lead generally to the doubt if classical thinking is here still applicable. Follower of the Copenhagen interpretation deny this absolute and this opinion was propagated as modern physics. Follower of the so called modern physics are the one group and the other is Schrödinger practical alone. Einstein could here not fixing himself for his relativity theory transgressed the classical scope too.

3.2. The Schrödinger-equation as formula of vortex dynamics

In part I, section 6 was already mentioned that in vortex dynamics the interaction determined not the acceleration but the velocity, therefore instead of the second derivation to time is to use the first. Sommerfeld could wrote the classical wave equation and the Schrödinger-wave-equation so that they differ, without the factors h and i, only that the classic wave equation uses the second derivation to time and the Schrödinger equation the first. So Sommerfeld had unconsciously proved that the Schrödinger-equation can be a formula of vortex dynamics. There vortex dynamics belongs to classical physics, so now we can give right to Schrödinger. So interpreted indeed the Schrödinger-equation is a return to classical thinking. It is true, Schrödinger spoke of waves but he meant with it eigen-frequencies and they permit off-hand an interpretation as rotations in deformable medium. The successes of the Schrödinger-equation, which is used equivalently in Heisenberg-Bohr's quantum theory with Heisenberg's matrices, therefore are successes of vortex dynamics.

Schrödinger [65] accented that should be used instead wave-equation the denotation oscillation- or amplitude-equation. The classic wave-equation is to obtain out of Maxwell's equations only with substitution of Hertz 's vector or a help-vector, both defined by a curl-term. The vortex structure was only veiled by this mathematical trick. Only few authors call attention to this fact, e. g. Emde [66], for the fields remain vortex fields.

As remarked in part I, section 6, diffraction could be described qualitatively by photons with the structure of electromagnetic vortex-pairs. With it diffraction of photons or light-particles is to explain classically as their turning or deflection.

3.3. Problems in introduction of structures

According Finkelnburg [67] the next problem of quantum-theory was the unsolved structure of elementary particles. As obstruction there effected hitherto Heisenberg-Bohr's quieting-philosophy, for the dualism of wave and corpuscle pretended a formal structure and the probability opinion kept away from profounder understanding of present structures.

There in last time theoreticians nearly only worked in Heisenberg-Bohr's quantum theory, so other spheres remain practically neglected as e. g. vortex dynamics. Here the case lies before which Einstein [68] described in his Berlin inaugural-speech (translated): „But as long as not are found the principle which serve as basis for deduction, so long the theoretician has no use of facts of experience; indeed he can not do even something with empirical found laws. He must rather remain in the state of helplessness till principles has opened to him which he can make to the basis of deductive development."

The possibility of Schrödinger-equation as formula of vortex dynamics give hope of a speedy close termination to finish the state of helplessness. The transformation from dynamics to vortex dynamics will correspond to the complementary and will replace this.

Out of these facts, considerations and former sections yield that a return to classical thinking is not only possible but necessary by way of trial. Therefore Schrödinger is right. By way of trial because this question is first completely answered, when the question of origin of quantization is solved definitively.

3.4. The indescriptness at quantum-processes

Out of Copenhagen-interpretation and Heisenberg's uncertainty-relation was concluded that quantum-processes have to be indescript. According to that it is senseless to treat these problems otherwise as mathematical formal. Against it already Schrödinger [69] put in contradiction (translated): „From philosophical standpoint a final decision in this sense I would deem equal a complete lay down of arms.For we can not change arbitrarily our form of thinking and what we can not understand within we understand this not at all. There are that things - but I do not belief that the structure of atoms belongs to it"

Popper [70] judged this exact so (translated): „So far as causal meta-physics is very more fruitful in its effect than indeterministic meta-physics, as it is advocated by Heisenberg; we see indeed that Heisenberg's formulations have paralytic effected on research. Our examination let recognize that even near to hand coherences could be overlook, if us always again is hammered in that a search is 'senseless' for such coherences."

Stapp [71] wrote. „Textbook accounts of the Copenhagen interpretation generally gloss over the subtle points. For clarification the readers are directed to the writings of Bohr and Heisenberg. Yet clarification is difficult to find there. The writings of Bohr are extraordinarily elusive. They rarely seem to say what you want to know. They weave a web of words around the Copenhagen interpretation but do not say exactly what it is. Heisenberg's writings are more direct. But his way of speaking suggests a subjective interpretation that appears quite contrary to the apparent intentions of Bohr."

The foundation of this mysterious description can be now founded with the papers of Nieke [47] and in part I section 3. There he had established that the alleged proof of wave by Fresnel based on an inadmissible and wrong extrapolation. Therefore Bohr and Heisenberg had to justify a field which based on an inadmissible and wrong extrapolation. There is easily to see that this is only possible with a mysterious description.

The considerations in this book related to the Copenhagen interpretation which is refuted by experiments. Stapp [71] considered critically the whole quantum-theory and stated their pragmatic character which lead to Copenhagen interpretation and quantum-theory. Bunge [72] explained this in details. He objected the principle of 'observables', represented by a linear hermitian operator, the correspondence principle and then the superposition principle. The complementarity principle he do not considered as heuristic or path-finding but just the opposite, its role being to petrify and excuse difficulties in the usual presentations of quantum-mechanics.

3.5. New statements

1913 Bohr [73] began to calculate the atom according the planet-model. The magnetic moment of the electron was discovered first 1925, but to this time Bohr had commit themselves that atom and quantum-theory were not classically calculable. Then calculations with magnetic moment are not carried out.

1925 Pauli [74] concluded from the magnetic moment of electron to the spin of electron. He concluded rightly that it could not be a simple rotation. But the spin as formal spin-quantum-number was not right, specially he assigned to the 180° turned electron the negative spin. A right-screw turns by turning 180° perpendicular to the longitudinal axis not to a left-screw. He had to reserve the negative sign of spin for the opposite direction of rotation. As then 1932 the positron was discovered, it had to get the opposite sign of spin. But the designation of spin does not be altered. Nieke [48] concluded for magnetic moment and spin the structure of vortex-aggregate with inner rotation and proposed an alteration of spin designation.

Since 1960 it is allowed for elementary-particles to have a structure, for it is to call the name Hofstadter [75]. However, for photons and electrons was prescribed the dualism of wave and particle, here was discussed no structure.

In spontaneous emission the emission of photon take place only after a lifetime about 10^{-8} second, but that are for visible light about 10^{6} periods. By Nieke [48] in this time is built up the photon, it is in this time in 'status nascendi' and not a virtual photon as by Bohr, Kramer and Slater [76]. The energy of stimulation is accordingly stored in half-period manner as vortex-energy until the energy h f is stored. After that the photon is emitted, that is it moves with velocity of light as photon with the structure of vortex-pair, or as well the two vortices with opposite sense of rotation drive forward themselves with the velocity of light. Therefore there is no quantum-jump.

After Chern and Simons [77] had out of group-theoretical investigations point to the invariant J(s) = I(s) mod 1, (that is a vortex-field), this is introduced in quantum-field-theory and quantum-electro-dynamics. Here was made up least formally the consideration of mag- netic moment of electron, what Bohr 1925 had neglected. Nieke [78] showed that the same is to reach with consideration of magnetic moment of electron in the atom. The magnetic moment of the electron was by him designated as 'vortex-propelling', which originates and maintains the magnetic vortex-field, and not as magnetic dipole or virtual monopole.

Now we can ask the question, if a return to classical thinking is not possible for this reason too.

4. To Einstein's philosophy

4.1. Einstein's and Bohr's relations to philosophy and religion

Einstein was also attacked in USA because his pacifistic mentality and this side reproached to him atheism. By Jordan [79] for this reason the rabbi of New York telegraphed to Einstein (translated): „Believe you in God?“ Einstein telegraphed back: „I believe in the God of Spinoza, who proves in harmony of all being, not in a God who is engaged in the fate of human.“

Spinoza lived 1632 - 1677 in Holland, was instructed a rabbi but because his free religious perception excluded out of the parish. Then he earned his livelihood with grinding of optical glass, wrote many important books, and died poor from Tb. He advocated a pantheistic standpoint: Besides God there are no other substance, all reality (substance), God, and nature fall together in one. He denied the dualism of mind or soul and body or matter. He denied the indeterminism, all is by him determined but no world-plan is existing.

Einstein [80] reported about the relation of science and religion (translated): „For science can establish only what is, not what should be; ... But the religion has only to do with estimation of human thinking and doings;“ . . . „That the idea of the existence of an omnipotent, all-bountiful, and righteous personal God can give people consolation, stay, and guidance; probably nobody will this disavow. . . . In his reward and punishment he would judge certain extent himself. How is this than to consistent with the justice and goodness attributed to him?“

Einstein attacked the dualism of wave and particle, he ([18]) demanded the fusion of these contradictions. Then he appeared de- cidedly against the indeterminism, all was causal conditioned, if the mechanism is unknown too. He was convinced: ‘God does not dice’

Bohr was influenced on the religious-philosophy of Kierkegaard, with which he was known in the parental-house through the philosophy professor Höffding ([81])who was friendly with his father. Later Bohr heard lectures also by Höffding.

Kierkegaard lived 1813 - 1877 in Denmark. He studied theology, got soon in conflict with the Denmark-church. For he had inherited from his father a little property so he was not unconditionally dependent from a pastorate and could so preserve his independence. The inheritance reached with unpretending life just till his dead. He advocated the dualism of soul and body, the indeterminism to preserve the arbitrariness or actions-ability for God, and the jump in the mind-living (erratic became out of Saulus a Paulus). He established on Hegel's dialectic so his philosophy is also named as qualitative dialectics.

Bohr set on dualism of wave and particle, which he marked as complementarity. Then he advocated indeterminism in quantum processes, it is not necessary to know a mechanism for physics is indescriptive. the statement of probability is sufficient. Then he demanded the quantum-jump, during Schrödinger and Einstein demand for this a continual process.

Bohr answered to Einstein's God does not play disk: „But it can not be our task to prescribe God how he has to govern the world.“(Heisenberg [82]).

Indeed, the harmonize Spinoza - Einstein and Kierkegaard - Bohr is amazing. Nevertheless neither Einstein nor Bohr was regular religious, both are starting more from physics. However, in this paper the discussion Einstein-Bohr is decided in favour of Einstein, so must this not carry over to the laid-under philosophies. Out of dualism of soul and body there does not follow that of wave and particle, even one will agree lighten to that. Even a indeterminism in quantum processes is accepted so presupposed this not the action-ability for God or that he is engaged in the fate of human or fate is predetermined or not.

Nevertheless this analogy is interesting.

4.2. To Heisenberg-Bohr's quieting-philosophy

It is to answer the question what Einstein [19] meant with fine concocted quieting-philosophy or religion and Hund [12] with prejudiced stand-point.

With the dualism of wave and particle Heisenberg believed to be secured for all times$_3$ for if wave is set equal e-function with complex exponent or the corresponding trigonometric functions, so are representable with the Fourier-theorem all piecemeal monotone results. For every experimental result is piecewise monotone so Heisenberg [5] believed that him can happen nothing: You can be experimenting quietly in every case I can exhibit the result as wave, with waves or as wave packet. But if the function of wave is substituted by the structure of elementary particles, at which Heisenberg

had worked successfully, so are manifested fusion by Einstein and prejudice by Hund, and so escaped the so fine concocted theory (after Einstein) from Heisenberg and Bohr. With the structure of elementary particles instead of masspoints automatic their deformation is a theme of physics, for a non deformable elementary particle with structure is an unrealistic ideal-conception.

Also extreme convenient was indeterminism and indescriptness at quantum processes. A probability calculation would be enough and it was not necessary to take thought about the physical process, for at the beginning this was in consequence of indescriptness superfluous or impossible.

But with photons as mass-point neither Newton nor Einstein could gave an alternative mechanism. That was first about 1960 possible with introduction of structure for elementary particle. But one asks why was found not at once this statement? Fresnel's theory and the Copenhagen interpretation was already too firmly introduced with dualism of wave and particle as structure of photon and it was as quieting-philosophy very convenient. Final the Copenhagen interpretation was described in text books of physics as complete secured by ostensible missed counter-experiments. There is feigned the same relation as at the proof of impossibility of perpetual mobile and who would invent as idiot here the perpetual mobile,

Bohr was very worried that Einstein could not consent to his theory. However, Bohr's followers for that had over only a compassionate smile or sneer. It is a known fact that founders of a theory had better information about weakness of their theory as their pupils, they are fanatics.

4.3. Einstein's position to dialectics

Whether one named that as dialectic or not, everyone, not only a scientist, will his works or opinions examine for contradictions. Most it will be advantageous to discuss with others, but the success does not be sure for in science there are valid no votes by majority, but a discussion is useful in any case to clarify.

Dialectics as art of conversation was already used as method for development of conceptions, indeed to find truth, from the ancient Greeks. This method was developed e. g. by Xenon, Platon and Aristoteles. The sophists brought dialectics into discredit with fictitious-proves. Kant [83] tried to enlighten dialectics fictions by the transcendent dialectic. If the limits of experience are transgressed (transcendent), the dialectic is limited on synthetic knowledges a-priori. To day the classification a-priori is disputable, to put in order practical cases was always difficult. In the case of wave and particle this principle allows the right decision: 'fiction', for the starting points are here obtained unequivocally not a-priori. But this is only a negative successful application. After Kant [84] antinomies are laying in the reason and not in the object.

Hegel [85] extended dialectics for compensation oppositions by a higher third conception with thesis, antithesis and synthesis. The contradiction is by him the driving force and herewith he developed his philosophical system. The historical development had shown that the association of dialectic with materialism is not enough to create a useful criticism to exclude misdevelopments. With the dualism of wave and particle or complementarity dialectics was used according to the model of Hegel, if here the physical statements are more realistic as usual by Hegel.

Heisenberg [86] said 1958 (translated): „Moreover the cognition-theoretical analysis of quantum-theory, especially in the by Bohr given form, contains some features which reminded of methods of Hegel's philosophy."

Fischer [87] reported that Bohr wrote on a table in the Lomomossow-university Moscow:

„Contraria non contradictoria sed complementa sunt"

(Contrasts are no contradictions but supplements).

A quarter of a century before he had requested to furnish the Denmark elephant-order with the motto:

„Contraria sunt complementa"

According Einstein it has to call:

"Contraria convenienda sunt" (Contrasts are to unite).

On the contrary Einstein [18] advocated not the method of with higher conceptions extended dialectics, what will be clear that he demanded a fusion of wave and particle. It is to accept that Einstein advocated the sentence: 'In nature there yield no insoluble contradictions', for Einstein a. Infeld [88] wrote (translated): „Without the belief that it is general possible to describe the reality conceptional by means of our theoretical construction, without the belief in a inner harmony of our world, there could not be existenting a science of nature." Einstein was the better dialecticist, he

confidenced that for apparent contradictions in the sphere of nature there are always possible real syntheses without metaphysical constructions. Vollmer [89] confirmed the dialectic of Einstein (translated): "Who permits contradictions can not claim consequently truth or validity in meaning." Corresponding Bernstein (editor of Engel's works) [90] denoted dialectics as a snare or double-edged weapon.

4.4. Development of the dualism of wave and particle

Mittelstraß [91] wrote to dualism (translated): „The history of human thinking is paved with dualism: heaven and earth, good and bad, true and wrong, reason and sense, sprit and nature. Dualism make the world simple, and have long since reached science too.“ He tried to fuse dualism: „All science is mind-science. Not in a mind of that mind-science should be declared for the real victors in the contest of two-cultures-controversy, but so that mind is no isolated region (beside nature) or is alone philosophical thoughtfulness.“ This is a trial to unit without ache.

The dualism of wave and particle was introduced by idealistic disposed physicists and also philosophers. Because they advocated dualism of mind and body, this were easy for them. First after longer delay most materialistic disposed physicists accepted the dualism of wave and particle. Facts to this are quoted by Röseberg [92]. They did not that in philosophical conviction but In pragmatical causes, not to lose the joining to quantum physics, after Heisenberg [93] to can march with Heisenberg-Bohr's music-band. Most easy it was for the follower of dialectic materialism. The materialism forbid indeed the dualism of wave and particle but the dialectic opened a way as solution of contradiction. (Comp. Baumann a. SexI [94]. After this step was done, in all text books of dialectic materialism the dualism of wave and particle appeared as a model-example of use of dialectic materialism in physics. That the dualism of wave and particle represented no dialectic contradiction asserted already Kraeft a. Vogel [95].

Materialistic disposed physicists judged indeterminism differently. It was partly demanded and advocated as dialectic determinism as already described in section 2 in group 3 and 5. But partly accepted as described by Blochinzew [41] or Fock [96] with the argument that by Engels the materialism has to change its form with every epoch-making discovery in nature-science. But the epoch-making discovery was the discovery of quantization of electro-magnetic radiation and not the Copenhagen interpretation. Fock's opinion and similar problems are detailed described by Selleri [97].

It is interesting that dialectics by Hegel was worked up in different directions. By Kirkegaard and Bohr over dualism of wave and particle to 'Copenhagen interpretation' or 'basic philosophy'. On the other hand over Marx to the dialectic materialism where after some fights, the dualism of wave and particle was valid as a model-example for the application of dialectic materialism.

To close this section in harmony (afterwards is this to infer lightly) Bohr and his collaborators should admit that the general demand for complementarity, indeterminism and indescriptness in quantum processes are precipitate conclusions for a universal validity. The refusal of general causality was authorized.

Einstein and his collaborators should admit that the demand for general keeping of causality was unauthorized, the inter-action had to be put in the fore-ground. Einstein should have read carefully the third book of Newton's optics.

Of course, it can objected that all was only proved with diffraction, and a generalization yet is risky. Against it is to object that these interpretations had been developed substantially at diffraction, and was generalized first later.

Literature II

[1] M. Born, Albert Einstein - Hedwig und Max Born - Briefwechsel. Nymphenburger, München 1969, S. 119.
The Born-Einstein Letters. Walker, New York 1971.

[2] N. Bohr, Atomic Physics and Human Knowledge. Interscience, New York 1965;
Atomphysik und menschliches Erkenntnis II. Die Wissenschaft Bd. 123, Vieweg, Braunschweig 1966, S. 5.

[3] B. Bavink, Ergebnisse und Probleme der Naturwissenschaften. Hirzel, Leipzig 8. Aufl. 1944, S. 174.

[4] C. F. Frh. v. Weizsäcker, Die physikalische Interpretation der modernen Physik. Nova acta leopoldina NF 37/2 Nr. 207 (1972).
[5] W. Heisenberg, Die physikalischen Prinzipien der Quantentheorie. Hirzel, Leipzig 1930, S. 7; The Physical Principles of the Quantum theory. Chicago 1930.
[6] As [5], S. 109-112; 1942: S. 107-110.
[7] R. P. Feynman, R. B. Lighton u. L. Sands, Feynman Lectures of Physics. Addison, Read. Mrss. 1964/5;
Feynman Vorlesungen über Physik. Bd. III, Quantenmechanik. Oldenburg, München-Wien und Addison-Wessly, London 1971, 1-1.
[8] W. Westphal, Physik. Springer, Heidelberg, Berlin 1947, S. 537, 1956, S. 618.
[9] H. Hörz, Materiestruktur. D. Verl. Wiss., Berlin 1971, S. 192.
[10] A. Sommerfeld, Vorlesungen über theoretische Physik. Bd. IV Optik. Dietrich, Wiesbaden 1950, S. 88.
[11] R. W. Pohl, Einführung in die Optik. Springer, Berlin, Göttingen, Heidelberg 1948~ S. 317.
[12] F. Hund, Materie als Feld. Springer, Berlin, Göttingen, Heidelberg 1954, S. 379.
[13] M. v. Laue, Materiewellen und ihre Interferenzen. Akad. Verlagsges. Leipzig 1948, S. 40.
[14] L. de Broglie, La Physique quantique restera-t-elle indétermiste? Gauthier-Villars, Paris 1953; Phys. Bl. **9** (1953) 488-497 und 541-548.
[15] L. de Broglie, J. Phys. Radium **8** (1927) 225-241.
[16] D. Bohm, Phys. Rev. **85** (1952) l66-l93; **87** (1952) 389;
Rep.: D. Z. Albert, Spektrum d. Wiss. Juli 1994, 70.
[17] M. Born, Physics in my Generation. Pergamon, London, New York 1956;
Physik im Wandel meiner Zeit. Vieweg, Braunschweig u. Akademie-Verlag, Berlin 1953, S. 35.
[18] A. Einstein, Phys. Z. **18** (1917) 121.
[19] K. Przibram (Hrsg.), Schrödinger, Planck, Einstein, Lorentz, Briefwechsel zur ‚Wellenmechanik. Springer, Wien 1963, S. 29.
[20] As [1], S. 173.
[21] E. Schrödinger, Abhandlungen zur Wellenmechanik. Barth, Leipzig, 1927;
Collected Papers of Wave Mechanics. Blacki, London, Glasgow 1928.
[22] A. Landé, Ann. Physik (7) **33** (1976) 88.
[23] W. Pauli, Aufsätze und Vorträge über Physik und Erkenntnistheorie. Vieweg, Braunschweig 1961 S. 20;
Collected and Selected Papers. New York 1964.
[24] M. Jammer, In: Einstein Symposium Berlin. Lecture notes in physics, Bd. 100. Springer, Berlin, Heidelberg, New York 1979, S.146-167.
[25] M. Bunge, as [24], S. 204-219.
[26] U. Röseberg, Szenarium einer Revolution - nichtrelativistische Quantenmechanik und philosophische Widerspruchsproblematik. Akademie-Verl., Berlin 1984.
[27] F. Kaschluhn, Einstein und die Deutung der Quantenmechanik. In H.-J. Treder (Hrsg.), Einstein-Centarium 1979. Akademie-Verl., Berlin 1979, S. 176-186, Zitat S. 186.
[28] H. Nieke, Newtons Beugungsexperimente und ihre Weiterführung. Halle 1997, Computer Print 1, Arbeit 1.
Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 3, paper 1.
[29] M. Planck, Wege zur physikalischen Erkenntnis. Vortrag 12. 11. 1930: Positivismus und reale Außenwelt. S. 201.
[30] As [1], S. 221 und 224.
[31] M. Vogel, Physik und Philosophie bei Max Born. D. Verl. Wiss., Berlin 1968.
[32] W. Heisenberg, Der Teil und das Ganze. Piper, München 1969 S.132.
[33] G. W. F. Hegel, Encyclopädie der philosophischen Wissenschaften im Grundrisse. Hsg. H. Glockner: Sämtliche Werke Bd. 6, Frommann, Stuttgart 1927, S. 173, § 220.
Transl. W. Wallace, Oxford 1874.
[34] K. Marx, Das Kapital Bd. 1. Dietz, Berlin 1958, S. 18; Marx-Engels Werke, Bd. 23, Dietz, Berlin, S.
27.
Capital. Transl. O. Torr, Allen, London 1938.; Transl. E. a. C. Paul, Dutton New York 1930.

[35] H. Hörz, Materialistische Philosophie und Naturwissenschaften. Akademie-Verlag, Berlin 1974, S. 323 u. 399.
[36] W. Heisenberg, Physics and Philosophy. Allen London 1951;
Physik und Philosophie. Ulstein Buch Nr. 249, Berlin 1959, S. 118.
[37] N. Bohr, Atomic Physics and Human Knowledge. Wiley, New York 1958;
Atomphysik und menschliche Erkenntnis 1. Die Wissenschaft Bd. 112, Vieweg, Braunschweig 1958, S. 5 u. 9.
[38] M. Born, Physics in my Generation. Pergamon, London 1959.
Physik im Wandel meiner Zeit. Vieweg, Braunschweig und Akademie-Verlag, Berlin 1953, S. 35.
[39] M. Born, Z. Physik **38** (1926) 203.
[40] As [5], S. 44 und 45.
[41] D. J. Blochinzew, Grundlagen der Quantenmechanik. D. Verl. Wiss. Berlin 1953, S. 493-501, 6. Aufl. 1967, S. 571-573.
[42] C. F. v. Weizsäcker, Aufbau der Physik. Hanser, München, Wien 1985, S. 301.
[43] M. Planck, Der Kausalbegriff in der Physik. Barth, Leipzig 1932, S. 23
[44] I. Kant, Kritik der reinen Vernunft. Hrsg. Schmidt, Reclam 6461-6470, Leipzig 1944, S. 47 und 611;
Critique of Pure Reason. Transl. I.M.D. Meiklejohn 1881, 1934;
Imanuel Kant's Critique of Pure Reason. Transl. M. Müller, Macmillan New York 1907, 1927, 1933.
[45] As [1], S. 118 und 226.
[46] As [5] 1941.
[47] As [28], paper 2.
[48] As [28], paper 13.
[49] A. Schlipp (Ed.), Albert Einstein, Philosopher - Scientist. Evaston (USA), 1949 and 1951;
Albert Einstein als Philosoph und Naturforscher. Kohlhammer, Stuttgart 1956, S. 413-14.
[50] K. M. Meyer-Abich, Korrespondenz, Individualität und Komplementarität - Eine Studie zur Geistesgeschichte der Quantentheorie in den Beiträgen von Niels Bohr. Steiner, Wiesbaden 1965, S. 159-160.
[51] E. Schrödinger, über den Indeterminismus in der Physik. Barth, Leipzig 1932, S. 15.
[52] As [28], paper 19.
[53] As [14], S. 547.
[54] E. Schrödinger, Nature and the Greeks. Univ. Press, Cambridge 1954; Die Natur und die Griechen. Rowohl Nr. 28, Hamburg 1956 S. 25.
[55] As [44], S. 302.
[56] As [33], S. 91, § 103.
[57] H. Hörz, Der dialektische Determinismus in Natur und Gesellschaft. D. Verl. Wiss. Berlin 1971, S. 91.
[58] W. v. Goethe, Maximen und Reflexionen. Nr. 1234 oder 609 je nach Ausgabe.
Maxims and Reflections. Ed. S. Draghici, Plutarch Press Washington.1997.
[59] L. de Broglie, Physique et mikrophysique. Paris 1947;
Physik und Mikrophysik. Classen, Hamburg, Baden 1950, S. 233;
Physics and Mikrophysics. Hutchinson's London 1955.
[60] H. Georgi, Sci. Am. (USA) **244** (1981) Nr. 4, p. 40;
Spektrum d. Wiss. (1981) Juni, S. 70.
[61] W. Pauli, (Ed.), Niels Bohr - and developments of physics. Pergamon 1955, p. 14.
[62] K. Baumann u. P. U. Sexl, Die Deutungen der Quantentheorie. Facetten der Physik Bd. 11. Vieweg, Braunschweig/Wiesbaden 1987, S. 22-23.
[63] As [51] S. 9
[64] As [1], S. 263.
[65] E. Schrödinger, Ann. Physik IV **81** (1926) 109.
[66] P. Emde, Quirlende Felder. Sammlung Vieweg H. 121, Braunschweig 1949
[67] W. Finkelnburg, Einführung in die Atomphysik. Springer, Berlin, Göttingen, Heidelberg 1956, S. 225.
[68] A. Einstein, Sitzungsber. Preuß. Akad. Berlin 1914, S.739.

[69] E. Schrödinger, Ann. Physik IV **79** (1926) 489, Zitat S. 508-9.
[70] K. Popper, Logik der Forschung. 9. Aufl. Mohr, Tübingen 1989, S.196. (Die Einheit der Gesellschaftswiss. Bd 4);
The Logic of Science. Hutchinson, London 1959.
[71] H. P. Stapp, Am. J. **40** (1972) 1098, quoated by [62] S. 16.

[72] M. Bunge, Foundations of Physics. Springer Tracts in Natural Philosophy Vol. 10, Springer, Berlin, Heidelberg New York 1967.
[73] N. Bohr, Atomic Theory and the Description of Nature. Cambridge 1934, 1949.
Atomtheorie und Naturbeschreibung. Springer, Berlin 1931, S. 35.
[74] W. Pauli, As [23], S. 120-146.
[75] R. Hofstadter, Rev. mod. Phys. **28** (1956) 214; **30** (1958) 482;
Phys. Bl. **18** (1962) 193.
[76] N. Bohr, A. W. Kramers, I. C. Slater, Z. Phys., **24** (1924) 69;
Phil. Mag. **47** (1924) 785.
[77] S.-S. Chern a. Simons, Proc. Nat. Sci. USA **68** (1971) 791; Ann. of Math. **99** (1974) 48-69.
[78] As [28], paper 17 and 20.
[79] P. Jordan, Albert Einstein - Sein Lebenswerk und die Zukunft der Physik. Huber, Fraunfeld u. Stuttgart 1969, S. 267.
[80] A. Einstein, Out of my later years. Phil. Lit. New York 1950;
Aus meinen späten Jahren. D. Verl.-Anst. Stuttgart 1970, S. 41.
[81] H. Höffding, Sören Kierkegaard als Philosoph. Frommann, Stuttgart 1896.
[82] As [32], S. 115.
[83] As [44], S. 125-126 und 330-423.
[84] As [44] S. 497, 630.
[85] As [33] S. 111, § 132-139.
[86] W. Heisenberg, Wandlungen in den Grundlagen der Naturwissenschaft. Hirzel, Stuttgart 1959, S. 172.
[87] E. P. Fischer, Niels Bohr. Piper, München 1987, S. 116.
[88] A. Einstein u. L. Infeld, Die Evolutionen der Physik. Rowohlt, Hamburg 1956, S. 195;
The Evolution of Physics. Simon a. Schuster, New York 1961.
[89] G. Vollmer, Naturwiss. **77** (1990) 49, Zitat S. 52.
[90] E. Bernstein, Zur Geschichte des Sozialismus. Dümmler, Berlin, 1904, Teil III, S. 75 und 80.
[91] J. Mittelstraß, Phys. Bl. **49** (1993) 267.
[92] U. Röseberg, Quantenmechanik und Philosophie. WTB 192, Akademie-Verlag, Berlin 1978, S. 149 - 162.
[93] W. Heisenberg, Schritte über Grenzen. Piper, München 1973, S. 321;
Across the Frontings. Harper, New York 1974.
[94] As [62], S. 29-32, 130-139.
[95] W. D. Kraeft u. H. Vogel, DZfPh **18** (1970) 341.
[96] V. A. Fock, Quantenphysik und philosophische Probleme. In: Hrsg. S. Wolgast u. K. F. Teinz: Dialektik in der modernen Naturwissenschaft. Akademie-Verlag, Berlin 1973, S. 124.
[97] F. Selleri, Die Debatte um die Quantentheorie. Facetten der Physik Bd. 10, Vieweg, Braunschweig/Wiesbaden 1983, S. 67-68.

Appendix

III. Brake Blocks for Progress in Physics

Index Page

Causes are put together which can lead to brake blocks for progress in physics. Corresponding to the title of this book there are set in the foreground the embezzlement of Newton's diffraction experiments, but the description is not limited on this at which in the extension no completeness is aspect.

1. Quieting Philosophy /Reassurance-

The effect of quieting philosophy as brake block for progress in physics was already described in detail in part II: Philosophical consequences out of Newton's diffraction experiments. By Einstein [1] is this strikingly marked in a letter to Schrödinger 1928 (translated): „The Heisenberg-Bohr's quieting philosophy - or religion? - is so finely concocted that it delivers to the believers in the meantime a soft resting pillow of that he is to scare not so easily."

These explanations should not be repeated here.

2. The pseudo-helpers of physics

It is usual, useful, and necessary to use results from other fields of science everywhere it is possible. If only ignorance in physics is shove off, without they keep ready a real explanation, so is to speak of pseudo-helper of these spheres of science.

2.1. Other parts of physics as pseudo-helper

The Copenhagen interpretation was so exhibited in text books as experimentally completely secured by missing counter-experiments. With this design was wilfully evoked the impression as existented the same conditions as in impossibility of perpetuum mobile. So believers were restrained to make experiments, and those who nevertheless experimented could not publish their papers, they were classified as idiots who would invent here the perpetuum mobile. Indeed the impossibility of perpetuum mobile was secured by innumerable experiments. Other the things in Copenhagen interpretation. Already the introduction was possible only by embezzlement of Newton's diffraction experiments. These refuted already with inner diffraction fringes of slit and localization of bent light that light never can be a wave and excluded inderterminsm. But with this trick was reached that the Copenhagen interpretation could keep alive over 1960, nevertheless after 1960 it was possible an explanation without Copenhagen interpretation with the structure of elementary particles. With consideration of Newton's diffraction experiments the Copenhagen interpretation loses its basis.

2.2. Mathematics as pseudo-helper

Beside experiments and observation represented mathematics the most important instrument of physics. To a pseudo-helper mathematics will become in two cases:

1st: Is given up descriptness, so is given up physics, for without physical interpretation a formula is empty. Than mathematics will be the supporting construction and a pseudo-helper. Examples: Fourier-theorem and probability calculation as in part I was detailed verified

2nd: If a mathematical representation is seen as general-valid and is physical interpreted, although this exhibitation respects only a part of the experiments, so mathematics become a pseudo helper. This case considered at the interpretation of diffraction in large distances by Fresnel. There lay before an inadmissible and wrong extrapolation to short distances with the conclusion for light as wave. This was discussed in detail in part I.

2.3. Sense-physiology as pseudo-helper

Mach [2] established at the rotating disc named to him light and dark rings, which he could photograph. From this he should conclude that there is a physical effect. But he chosed the outlet to physiology and supposed that as well sensibility of eye as density of photographic material are dependent from the second differential quotient of intensity to locality. Nieke [3] showed by measurement with objective radiation detectors that Mach's rings were a physical effect and he explained this with moment photos as diffraction at moved edges.

A further example to sense-physiology offer Grimaldi's luminous edge which he found before Newton. Newton part I [3], III observation 5 established that the fine light line was so smaller so more sidewards he observed. Sommerfeld [4] concluded from his diffraction theory with Huygens' principle as starting point that from the edge no light is starting. So he marked Grimaldi's luminous edge as a non permitted extrapolation of the eye. He used the physiology as pseudo-helper and did not doubt in the correctness of his theory, although he denoted his theory as an approximation. Indeed, from the edge there is coming no light, but out of the near surroundings of the edge, whereas after Sommerfeld bent light should be coming from the whole slit. Nieke [5] established unequivocally in the schlieren apparatus that bent light comes real out of the surrounding of edges. With it Grimaldi's luminous edge is unequivocally a physical effect.

3. Suppress of experiments which contradict the theory

3.1. General

Vollmer [6] wrote to this (translated): „Quite too light and quite too frequent science is (dis)understanding as a great mosaic to which is to add stonelet to stonelet. Such a cumulative model is not only advocated by a failured science-theory, but it is also obviously through the building-up of

lessons and our text books. Teached is in them natural only right things: There are asked only right questions, collected only serviceable results and given only right explanations.“ Goethe [7] let say Mephistopheles about the collegium logicum (translated): „There will braked in the mind you well, laced in spanish boots, ...“. More popular is Palmström’s [8] conclusion that „not can be, what not dare to be.“ It is therefore an usual praxis simply to leave out experiments and conceptions which do not fit in theory or teach concept. So was referred in part I that Fresnel I [4] communicated only results in slit-far which corresponded his theory.

Certain many readers have take part in a speech for defence where is reported of experimental results which agree with the theory partial and partial not. There where the results agree with the theory nobody asked for exactness of measurements or methods of experiments for this part the referent had properly could spare for this was clear in any case. Different there where the results do not agree with the theory, there was asked intensively for exactness of measurement and methods of experiments. Even the referent answered all pacify, so remain the under-sound of the questioner: Then, what he had measured? For so many famous text book authors have copy from another, so this will be sure true. A hearer or the referent will well consider if he in future will report about derivation form the theory, or as Fresnel break off the communication at unsuitable measure-results. Moreover is to consider that every experimentator will work particular critically and carefully at derivation from theory. What follows further is dependent if the measurements which differ with the theory have a technical importance or not. If lies before a technical interest, so will the results be verify and used technically in confirmation. Is there no immediate technical application (as in diffraction), so remain these results of discrepancy unmentioned, and can become so a brake-block for the progress in physics.

3.2. Newton's diffraction experiments

About the case of embezzlement of Newton's diffraction experiments is reported in part I and II. For veiling of the inadmissible and wrong extrapolation for diffraction at the slit for great distances to short distances, the contradict diffraction experiments by Newton were embezzled and no more reported. Hall [9] reported Newton's book III only shortly but he wrote: „... a clearer, more exact and more detailed account of diffraction than any of his predecessors.“

3.3. Special cases

Also the review-system works hinderly in this case for progress. In the case of a paper with experiments which contradict an acknowledged theory a reviewer has to confirm in writing that he had believed on somewhat wrong or he is disappointed in an inadmissible generalization. That is not expected to him and so he will refuse the publication of this paper. This leads to a modern method of inquisition. Therefore it is to demand for such cases a possibility for publication where only the author sign responsibly.

Kuhn [10] marked the suppression of experiments which contradict an acknowledged theory that theory is immune against falsifications. There and also general this method is insufficiently condemned, for this method hinders authoritatively the progress in science. An experiment which confirm the theory is a good experiment but an experiment which contradict the theory is to consider with scepticism. This can not be stigmatized enough not only in historical sight but also in sight of brake blocks.

But also in publicated results reported Kuhn [10] about many cases where experiments which falsify acknowledged theories, but this experiments are considered not or only as an exception. So reported Eickenjäger [11], that formula and experiments which regarded Ohm's law, was valid for years as undesirable.

One wishes to know many, but this knowledge should conceive in possiblest few general and simple laws. Few laws are often considered as importanter as to increase the knowledge. Stegmüller [12] confirmed this method at other occasions (translated): „... if whole generations of investigators miscarried to employ the theory success-fully. In such a case will be take one day the conclusion to remove this sphere out of the classification of intended applications. So one had after asserted under experts the conviction, that Newton's hope to explain the phenomenons of light with the classical particle mechanics is unrealizeable, not declared Newton's theory for falsificated but concluded reverse that light is not consisting of particles.“

How long an inadmissible generalization can effect, is to see by Ramsauer [13] yet 1953 (translated): „Fresnel had proved with his mirror experiment the correctness of undulation theory so forcible that with it a century-long dispute is finished once for all.“ In reality Mach [14] had already shown that with that is proved only the periodicy of light and no more.

Hertz [15] however did not used the method Fresnel's, he called attention on discrepancies of the theory (translated): „Whilst we tried to explain the observations out of Maxwell's theory, it is us not succeeded to remove all difficulties. Nevertheless one may consider the completeness with this theory give back the most of appearances, as a not to be sneezed result of them.“ To this is to mark that discrepancies appeared in the field of radiation of dipole in distance of transform of field-strength from $\bar{r}^3$ in the near-field to $\bar{r}^2$ in the distance-field. But since begin of our century it is known that electromagnetic radiation is quantized, so should be quantized the by Hertz described radiation too. If radiation is quantized in distance-field so has this by Nieke [16] took place immediate after origin, therefore in the transform-sphere where Hertz found the discrepancies with Maxwell's theory. Here remained experimental results unnoticed because of a simple theory, formulas for interpolation satisfied for reassurance.

4. Formal mathematic exhibitions and models

4.1. General

To a formal mathematical exhibitation as brake-block for progress in physics directed Rompe a. Treder [17]. The Ptolemaios' picture of world allowed to calculate the locality of celestial bodies ever exacter with addition ever newer excentres and epicycles. They brought this in parallel to the theory of elementary particle where were introduced even new primary matter (quarks, leptones) and quantum numbers (strangeness, charm, colour ...). A formal right calculation proved therefore not the justness of out this derived theory, also if it is logical closed.

Einstein [18] wrote (translated): „Experience remains natural the only criterium of usefulness of a mathematical construction for physics. But the proper creative principle lies in mathematics.“ In the last sentence mathematics is overestimated, it is enough as counter-argument to call the name Faraday. In other connection Einstein wrote (translated): „So far the sentence of mathematics refer to the reality they are not sure, and so far they are sure they relate not to the reality.“

4.2. Special cases

A negative influence can have mathematics as reported in section 2.2 on physics if a formalism permits to calculate every result as pleasure, therefore also the contrary. For example should be stated the Fourier theorem with it all picewise monotone functions are representable, therefore every experimental result. Fresnel could lightly calculate the outer diffraction-fringes of slit in very great distances. This formula he extrapolated to the distance nought and established so his statement over diffraction with Hugenes' principle, but this extrapolation was already refuted by Newton with the proof of localization of bent light in small surroundings of edges and the existence of inner fringes of slit. To this formula is declared as presumption that distance has to be great against wavelength. With it already the inadmissibility is obviously.

Integration over the full slit plane with this principle gave still not the full freedom. These was procured with the acceptance of a phase jump, which only was inferred out of not-agreement with the experiment. With this trick was obtained that every result was calculable and so the incorrect extrapolation was veiled.

Bell [19] wrote in his paper against the 'measurement' (translated): „I mean solely that the theory has to formulate completely in the speech of mathematics, and should not leave in the own discretion of theoretical physicists - at all events till the point where useful approximations are need for application.“ The speech of mathematics here based on the Fourier theorem and probability calculations, with that are fit all experimental results for representation. So he inferred: „The usual quantum mechanics is completely sufficiently for all practice related problems.“

There already Newton had proved with localization of bent light that light never can be a wave and diffraction is no indetermistic process. So Bohr established his quantum theory with the dualism

of wave and particle and the indetermism at quantum processes on wrong foundations. So also Bell's opinion is without basis, he had be interesting in Newton's diffraction experiments.

With models was tried to preserve the descriptness where objects are not tangible, so at micro or cosmic objects. A too primitive model is willingly extended mathematical formal if the perfect model is mathematical too difficult. That was and is the case in quantum theory and the theory of elementary particles. There was tried first with mass-points, than with rotating rigid bodies, and final mathematical formal. For atoms as well elementary particles have a structure, there is besides electro-dynamics to use the mechanics of deformable media in which appear besides deformation also polarisation. As manifoldly demanded this fact is also to respect at elementary particles, even the mathematic difficulties are great. Einstein [20] wrote (translated): „God does not trouble about our mathematical difficulties, he integrated empirically."

4.3. The research-method of bottom-up and top-down

In the method bottom up first experiments are collected out of literature and then new experiments are placed for completion and perfection. First, if all experimental materials are sufficient together, then the statement of theory is beginning to explain and if possible to calculate all the experiments.

In the method top-down is proceeded from ideas, principles, philosophies, mathematical formalities or presentations which have approved or for which is to suppose a general validity. This method often had be approved (e.g. Einstein's general relativity-theory).

This method becomes critically if for furtherence of resarch are put in public finances. Then only is searched in that direction for which is to expect a confirmation of this theory, critical experiments or considerations are not placed. Also in tenth power higher disturbances is calculated something to show successes in order that funds run farther. Glotz [21] called attention to this states of affairs in cautious formulation. So originate not only brake-blocks, but also brake-dikes.

4.4. Further possibilities

Only directed shall to the problem of manifold infinite many solutions of partial differential equations, of them only one solution is used, therefore the mathematic formula is too wide

The danger of formal mathematical statements as brake-blocks for progress in physics will be raise by further spreading of computer technic, for often a computer program is enough for tick off a real physical problem.

4.5. Positive examples of formal exhibitions

But there are also many examples for positive stimulating effects of formal statements as e. g. Planck's equation of radiation, Balmer's formula and Schrödinger's equation.

5. Prejudices

5.1. Prejudices out of no-physical sources

Special dogmas of religions can hinder as prejudice progress of science. For the Christian religion offered the case Galilei the knowest example. However, prejudice is not limited on religious conceptions or directions.

As a model-example of a prejudice is valid Goethe's theory of colours, in which Goethe did not accepted Newton's prism experiments with small slit which did not corresponded to his wholly-statements. But that led not to a brake-block because Goethe did not be taken seriously by the physicists.

Einstein [22] wrote to prejudices (translated): „Only few are able to pronounce a from prejudice of surroundings different opinions, the most are even unable to come to such opinions." Schopenhauer [23] meaned more rigorous (translated): „The true and real should win more easy space in the world if not they, which are unable to produce it, together are forsweared it not to let arise. This circumstance has already several, that should to come for benefit to the world, hindered and retarded, if not even suffocated." This is sure not general valid for often persons, which have shown that they are able to independent thinking, nevertheless they have attacked other authorized insights.

5.2. Prejudice in physics

How a formal mathematical statement is leading with a reassurecnte-philosophy to a prejudice demonstrated Dirac [24] (translated): „The attempt should be aimless and senseless to penetrate deeper in the relation between wave and particle as it is necessary for this aim.“

Hund [25] wrote about wrong ways and restrictions in development of quantum theory (translated): „A consolation remains: More than a few years the development was not retarded therefore. It gives worse in history of physics, as about the application of Descart's version of the refraction law by Newton, which obstructed him in interpretation of interference fringes with light-waves." Here Hund went at astray, Newton examined and proved this independently, he erred only in velocity of light in high refractive materials. Reverse, light as wave obstructed the development nearly two hundred years.

Heisenberg [26] reported (translated): "Billions are disposaled ... But if is inspected where the most important successes are won in American physics in the last decade, so is to recognize, that more of this successes, perhaps the most importance, originate from outsider, which have gone their own way with little means, which not, with an American expression, join-marching with the music-band, but which obtained unexpected results of research continual in course of many years aside of the great highway."

But Sexl [27] wrote (translated): „An outsider has today scarcely no chance to bring a general idea to that ripeness which is necessary for their acknowledgement by science. This may be regrettable, however, that corresponded to the unalterable historical motion of physics and other science, which have built up out of simplest beginning a high differential system. An effective cooperation at this system demand an integration into the community of scientists which is to reach from the outsider not per definition“. This means that a fact is first accepted if for it is put forward a quantitative theory, without this the facts were not published.

After this both quotations there are least two sorts of outsider. If they work where exists no or not only one theory, over that obviously referred Heisenberg, there have outsider no difficulties to publish their papers. Other the things if only one general acknowledged theory is existing, on which referred Sexl, it was made difficult or impossible for the outsider to publish experimental or even theoretical papers or to bring their opinion to acknowledgement. Sexl reported about venial trials from a French resarch group of publications against the dualism of wave and particle.

Planck [28] meant to prejudice (translated): „A new scientific truth does not accustomed in carry through in the manner that their opponents explain self convinced, but rather that the opponents by and by die out and the grow-up generation will be make confidenced from beginning with the truth.“ This is to consent only conditionally, for before is to answer the question by Sommerfeld [29]: „What is truth?“ Here is yet Goethe [30] to quote (translated): „Original own sense let not rob yourself! At what the multitude is believing, is easy to believe.“ This is a recipe which leads not in all cases to success, as Goethe self showed in the theory of colour.

5.3. Further causes

As deeper cause of prejudice can yield also an inexpedient limiting of sphere of investigation. So Fresnel limited his sphere partial too narrow and let out essential parts. Goethe on the contrary would catch too many at once and did not divide physics and physiology. It is very easy to establish this in historical distance, so much difficulter it is to find the suitable limiting during the resarchework.

Under prejudice can also valid the vanities which also under scientists can play a not to neglect roll. According condition and social positions of the contrahents can such vanities become to brake-blocks, although in most cases they will remain in the personal plane.

Final it is a prejudice if the most simple or most harmonious was considered as the most right or the truth.

Often the accustomed structures of thinking is not to divide from prejudice. By Bergner [31] there is no speech of observation free from theory. This may be, but it is possible to endeavour for a most theory-free speech of observation. Certain is the opinion of Laue II [13] that every interpretation of an experiment already contains theory.

6. Alteration of structures of thinking

6.1. General

Schrödinger [32] wrote to that (translated): „One has real the impression that science is hindered through deep-rooted structures of thinking, their some are difficultily to find, while others already are disclosed." Corresponding Broglie [33] (translated): „The history of science shows that progress of science was permanent hindered by the tyrannical influence of certain introductions which are final considered as dogmas.“ Experiments or theories which demand a change of structure of thinking yield a great resistance against these.

Heisenberg [34] described particular impressive this (translated): „Who works in the science is accustomed to become acquainted in the course of life new appearances or exhibitions, perhaps to discover self. ... But differently it is if new groups of phenomenon enforce changes in the structure of thinking. Here even important physicists have the greatest difficulties. ... A scientist which had achieved great successes in his research for years with a from youngth habitual structure of thinking, can not be prepare to change this structure of thinking based on few new experiments. ... If one has experienced the despair, with which in science intelligent and conciliate persons reacted on the demand to change the structure of thinking, he can in contrary only wonder that such revolutions in science were generally possible."

6.2. Scheme of thinking in diffraction

Special at diffraction and interference was valued the scheme of thinking: 'diffraction and interference are to explain with waves and only with waves' (after part I and II never authorized), and what then entered as dualism of wave and particle together with indeterminism into Copenhagen interpretation. The possibility of thinking of photon with structure leads now again to introduce a new structure of thinking what is again connected with the by Heisenberg [34] described difficulties. It should be lighter for a scientist to perceive this new structure of thinking, for it is offered experimental matter and a deterministic interpretation. On the contrary Heisenberg reported on an induction of an abstraction. More difficult will be this introduction of this structure of thinking, for by Einstein [35] the from Bohr and Heisenberg fine concocted reassurance-philosophy the believers deliver a soft resting pillow, from which they have to scare for sake of progress.

As contrahent of entered structure of thinking is valid the doubt, on which there are many quotations from „At all is to doubt“ till „doubt with healthy conservatism“. in the praxis preponderates the usual conservatism, how wide it is healthy, over that is to dispute.

Last is generally established that founder of theories know better the defects and weakness of their theories as their pupils. So Bohr was oppressed that Einstein could not chime in his theory. His follower have for this only a compassionate smile or sneer.

The development of science ensued at mechanics so that Newton's mechanics could take full over conceptional and mathematical, the special relativity theory completed Newton's mechanics for velocities near the velocity of light. Many persons wish this to generalize and consider this for the usual development of physics, for then science will be pretty convenient: The hitherto lesson remains fully as secured knowledge and on this building up is added the new knowledge. So indeed the development of science had been in optics if one would remain in the opinion of Newton. Then particles of light would become in the 20th century to quanta of light and after 1960 they are completed to photons with structure and returning field. For the development of optics did not go the direct way, but took as result of disregarded experiments the wrong way over wave and indeterminism, so is now necessary a change of conception for nature of light. However, from the mathematical formations keep remaining many as formal approach for special cases.

Here were not discussed the through function of the humane brain pretended structures of thinking and the perhaps thereby conditioned limitation.

7. Indescriptness and abstraction

7.1. General

If one asks over descriptness (sensual descriptness) to attain an uniform understanding, then can this lead to indescriptness or abstraction. Bohr and Heisenberg considered the give-up of

descriptness in quantum physics as the price for progress in science. But Goethe [36] meant (translated): „The abstraction we are afraid of.“ Kant [37] wrote (translated): „Then descriptness and conceptions constituted the elements of all our perception. ... descriptness without conceptions are blind."

7.2. Example quantum-theory

In the case of quantum theory could be shown with the here discussed experiments that abstraction is to fear, for one had accustomed to abstractions (habitual descriptness) so can be perceive as descriptive. Einstein [38] wrote (translated): „Conceptions, which have proved as useful in order of things, obtain light such an authority, that we forget their earthly origin and take that as unalterable facts. Then they are stamped to 'necessities of thinking or facts of a-priori'. The way for scientific progress is by such wrong-ways made impassable often for a long time.“

For the sake of progress is to risk an abstraction, but one has to be prepare to give up this again, according Schrödinger [39] (translated): „Physics mostly go the way of least resistance which is not ever a productive advance in the unknown, but is leading occasionally in inextricable bushes.“ Therefore on the one hand dare not be limited the theoretical research if one will erect a system of instruction on basis of few axioms, principles, sentences, work-hypotheses or special experiments. On the other hand dare not be concluded on fundamental unfathomableness or indiscriptnes because momentary ignorances, as in dualism of wave and particle, or indeterminism at quantum processes, for these lead to brake-blocks. The thesis of indiscriptnes in quantum-processes shows a precipitate restriction which can not be condemned hard enough. Examples by Laue II [13] and Popper II [70] (page 50 and 64).

7.3. A curiosity

At diffraction and interference there is to consider a historical curiosity. To protect descriptness analogue to the water-waves, light was considered as wave in the 19th century and the contradicting experiments Newton's, which with our present knowledge excluded the wave structure of light, are simple let out. As in the 20th century the quantum structure was proved, the then left out experiments were forgotten, and the for preservation descriptness introduced wave led to the dualism of wave and particle and so to the readiness to give up descriptness.

7.4. Positive examples

As positive examples of abstraction (insight descriptness) are named the powerless uniform motion by Galilei and Newton, the transition from Ptolemaios' to Copernicus' system of world and the relativity-theory with the question of simultaneousness by Einstein. A too great fear of abstraction or 'metaphsics' can so cause a damage.

Often it is objected that limitation of our five senses shall be an unnecessary limitation. The physicist will ever attempted not to be limit through this by inset of devices, but last end nevertheless we are depended of our five sense.

8. Defective introduction of newer knowledge

8.1. Pretended closed theories

If a new result will be introduced in physics, so should be examined the whole physics, if not also in as closed valid spheres a change or completion is necessary. But most this did not ensued, for which can be call examples:

Bohr started 1913 to calculate the atom. As 1925 the magnetic moment of electron was discovered, Bohr had already committed itself that the atom is not classically calculable. Never it was tried to calculate it with the magnetic moment of electron (cf. Nieke [40]).

Pauli defined 1925 the Spin, above all of electron, without knowledge of positron. As 1932 the positron was discovered, this definition was left as they are, although a new definition were necessary (cf. Nieke [41]).

Diffraction and interference are believed to explain only with waves. As in the 60th year of our century was found the structure of elementary particles, so it was omitted to examine diffraction and interference, althought a structure of elementary had allowed to explain diffraction and interference with particles. Nieke [42] showed several new interpretations with it.

For closed theories wrote Heisenberg [43] (translated): „The closed theory contains no secured statement about the world of experience. Because as far appearances could be seized with conceptions of this theory, remains in rigorous sense insecure and simple the question of success."

Closed theories could be originated also from suppressed experiments as considered in section 3. With the hint to these experiments this theory should be to throw down, but the difficulties are indicated in section 5 and 6.

8.2. Unfit exhibitions

On an other sort of defective introduction of new knowledge directed Krbeck [44] (translated): „At unfit exhibition remains the valuablest kernel uneatable as the nut in the peel. But which exhibition is suitable and which not, that decide the contemporaries." And: „But one is wrong believing that this public possesses the infallible look for real worth. It succumbed a skilful make-up accurate so as in the theatre and would like best to exert themselves just as little."

9. Inferences

Here could be shown facts which can form brake-block functions for progress of physics, but it was given no general recipe to avoid them certainly. One had best to avoid checks for progress in knowledge if without any reassurance-philosophy open all ignorances are confessed as this did Newton [45] (retranslated): „I have not could come to that, to divert out of experience the cause of heaviness, and hypotheses I do not think out." Analogue Schrödinger [46] (translated): „The resoluteness to resign with a 'non liquet', indeed, it to estimate as an incentive and signpost for further research, this is an attitude of mind which is natural and indispensable for a natural-scientist."

Literature III

[1] K. Przibram (Hrsg.): Schrödiger, Planck, Einstein, Lorentz, Briefwechsel zur Wellenmechanik. Springer, Wien 1963 S. 29.

[2] E. Mach, Sitzungsber. Akad. Wien, math.-naturwiss. Kl. Abt. II, **52** (1865) 303; **54** (1866) 131; **57** (1868); **115** (1906) 635.

[3] H. Nieke, Exper. Techn. Physik **31** (1983) 53.

[4] A. Sommerfeld, Vorlesungen über theoretische Physik. Bd. IV Optik. Dietrich, Wiesbaden 1950, S. 268.

[5] H. Nieke, Newtons Beugungsexperimente und ihre Weiterführung. Halle 1997, Comp. Print 1. Arbeit 2.
(Vorhanden in vielen deutschen Universitätsbibliotheken);
Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 3, paper 2
(Available in some university libraries).

[6] G. Vollmer, Naturwiss. **77** (1990) 49, Zitat S. 53.

[7] W. v. Goethe, Faust erster Teil, Schülerszene.
Transl. F. G. G. Schmidt, Stechert, New York 1935.

[8] C. Morgenstern, Palmström. Insel-Bücherei Nr. 318, Leipzig 1953, S. 67.

[9] A. R. Hall, All was light, an introduction to Newton's opticks. Clarendon, Oxford 1993, p. 124.

[10] T. S. Kuhn: The structure of scientific revolutions. Chicago 1962 and 1991;
Die Struktur wissenschaftlicher Revolutionen. Suhrkamp, Frankfurt M. 1973.

[11] K. G. Eickenjäger, Spektrum **7** (1976) H. 1, S. 38.

[12] W. Stegmüller, Neue Wege der Wissenschaftsphilosophie. Springer, Berlin, Heidelberg, New York 1980, S. 43.

[13] C. Ramsauer, Grundversuche der Physik in historischer Darstellung. Springer, Berlin, Göttingen, Heidelberg 1953, S. 8.

[14] E. Mach. Die Prinzipien der physikalischen Optik. Barth, Leipzig, 1921, S. 185 - 226;
The Principles of Physical Optics. New York 1960.

[15] H. Hertz, Ann. Physik (III) **36** 1889) 1;
Ges. Werke Bd. II, Barth, Leipzig 1892, S. 147, Zitat S. 170.
Electric Waces. Transl.D. E. Jones, Macmillan,London 1893

[16] As [5], paper 13.

[17] R. Rompe u. H.-J. Treder, Grundfragen der Physik. WTB 216. Akademie-Verlag, Berlin 1980, S. 21.

[18] A. Einstein, A Selection of Extracts for Writings and Speaks of A. Einstein. Amsterdam 1934. Mein Weltbild. Ulstein, Berlin 1956, S. 116.
[19] J. S. Bell, Phys. Bl. **48** (1992) 267.
[20] L. Infeld, Albert Einstein - Sein Werk und sein Einfluß auf unsere Zeit. Schönbrunn Verl. Wien 1953, S. 63.
[21] P. Glotz, Phys. Bl. **51** (1995) 1051.
[22] As [18], S.105.
[23] A. Schopenhauer, Die Welt als Wille und Vorstellung. Vorwort zur dritten Aufl., z. B. Hesse u. Becker, Leipzig 1919, S. 22.
The World as Will and Idea. Tranl.R. B. Heldane, London 1883.
[24] P. A. M. Dirac, Die Prinzipien der Quantenmechanik. Hirzel~ Leipzig 1930, S. 2;.
The Principles of Quantum Mechanics. Clarendon Press, Oxford1935, 1947, 1958.
[25] F. Hund, In: Hrsg. P. Dürr: Quanten und Felder. Vieweg, Braunschweig 1971, S. 10.
[26] W. Heisenberg, Schritte über Grenzen. Piper, München 1973 S 321;
Across the Frontings. Harper, New York 1974.
[27] R. Sexl, Phys. Bl. **30** (1974) 19.
[28] M. Planck, Naturwiss. **33** (1946) 231.
[29] A. Sommerfeld, Vorlesungen über theoretische Physik. Bd IV Optik. Dietrich, Wiesbaden 1950, S. 38.
[30] W. v. Goethe, Zahme Xenien. Zweite Reihe, Zeile 1714.
Goethe and Schiller's Xenions. Transl.P. Carus, Courl, Chicago 1896.
[31] H. Bergner, Die Natur als arbeitende Maschine. Campus Forschung Bd. 296, Frankfurt, New York 1982. S. 26.
[32] E. Schrödinger, Über den Indeterminismus in der Physik. Barth, Leipzig 1932, S. 26.
[33] L. de Broglie, La Physique quantique restera-t-elle indéterminste? Gauthie-Villars Paris 1953; Phys. Bl. **9** (1953) 488, 541, Zitat S. 548.
[34] As [26], S. 283.
[35] W. Heisenberg, Introduction to Uniform Field Theory of Elementary Particles. Interscience, New York 1966;
Einführung in die einheitliche Feldtheorie der Elemenarteilchen. Hirzel, Stuttgart 1987, S.116,
[36] W. v. Goethe, Vorwort zur Farbenlehre. Goethes sämtliche Werke, Bd. 34, Cotta u. Kröner, Stuttgart 1865, S. 19. Theory of Colours. Transl. C. L. Eastlake, London 1840.
[37] I. Kant, Kritik der reinen Vernunft. Hrsg. Schmidt, Reclam 6461 - 6470, Leipzig 1944. S. 125-126 und 380-423.
Critique of Pure Reason. Transl. I. M. D. Meiklejohn 1881, 1934.
Imanuel Kant's Critique of Pure Reason. Transl. M. Müller, Macmillan, New York 1907, 1927, 1933.
[38] A. Einstein, Phys. Z. **17** (1916) 101.
[39] A. Schrödinger, Brit. J. Phil. Sci. 1952, S. 1011.
[40] As [5], paper 17.
[41] As [5], paper 14.
[42] As [5], paper 12, 13, 14.
[43] As [26], S. 93.
[44] F. v. Krbeck, Eingefangenes Unendlich - Bekenntnis zur Geschichte der Mathematik. Geest & Portig, Leipzig 1952, S. 4-5;
First chapter from it: Phys. Bl. **8** (1952) 529-535.
[45] I. Newton, Philosophia naturalis principia mathematica. London 1687;
Übers. Wolfers: Mathematische Prinzipien der Naturlehre. Oppenheim, Berlin, 1872, S 511.
[46] E. Schrödinger: Nature and the Greeks. Univ. Press. Cambridge 1954;
Die Natur und die Griechen. Rowohlt Nr. 28, Hamburg, 1956, S. 14.

IV. Vortex Hypotheses for Structure of Matter

Index Page

Till the beginning of our century prominent physicists are engaged in vortex hypotheses to describe the structure of matter. To interpret quantum physics it was attempted in vain to represent atoms or electrons with rotating point-, rigid plane- or volume-charges. Consequently this should be tried with deformable matter, but because mathematical difficulties and missing structure of elementary-particle Bohr choose in his Copenhagen-interpretation a more convent way and inferred indescriptness as principle in quantum theory. The proof of localisation of bent light, its structure, and the possibility of the Schrödinger-equation to be a formula of vortex dynamics leads to a new stage. Additional in last time is shown that quantum theory did not consider sufficiently vortex-fields. With this is confirmed, what Einstein always had emphasized, that Heisenberg-Bohr's quantum theory was an incomplete theory. About the nature of incompleteness Einstein never had expressed oneself, he demanded only a deterministic theory.

1. Introduction

A look to Maxwell's equations shows that temporal changeable electromagnetical fields have to be always vortex fields. Already the curl of the plane wave is unlike nought, as it is light to verify, this also describes a vortex field.

Who says electromagnetic field (or wave), means vortex field too,
it don't care if it is conscious to him or not,
it don't care if it is agreeable to him or not.

It was an arbitrariness to consider only the amplitude as wave for authoritative quantity and not the curl as Cullagh [1] (cf. section 2).

The dynamics of vortices was neglected in our century, feared because their mathematical difficulties (e. g. forces which effect perpendicular to their directions have no potential, the principle-mechanics is not applicable), and this led to a ‘horror vortices’. There is a difficult research-field, but a rich in prospects one, as shown by successes of vortex dynamics in the interpretation of super-conductivity and superfluidivity. (The extensive literature to this is not quoted).

Vortex-dynamics is a part of hydro- and aerodynamics. Electromagnetic fields spread out (at least in vacuum) without friction, here will do the frictionless vortex dynamics. The mathematical difficulties appear above all in vortex-dynamics with friction. For conduction processes and magnetic change-processes, there are to respect unconditionally friction-processes (as collision-process).

Bohr [2] and Heisenberg [3] considered the giving up of descriptness in quantum theory as the price for the progress in science. This conception has asserted general as consequence of Copenhagen interpretation and is advocated in so called modern physics as doctrine. If nowadays as structure of matter were used vortex hypotheses, so the author is exhibited as a primitive person, who needs the antiquated descriptness. But to do justice to these authors, there are shown some objections of prominent physicists which are mentioned no more to day in text books.

Einstein [4] wrote 1928 to Schrödinger (translated): „The Heisenberg-Bohr's reassurance-philosophy - or religion? - is so finely concocted that it delivers to the believer in the meantime a soft resting-pillow of that he is not so easily to scare.“ And for the exclusive probability-statement: „. . . before one has

not defended against this quite otherwise that done hitherto.“ Schrödinger [5] said in a lecture (translated): „A wide spread teach-opinion states, that an objective image of the reality, in some earlier believed sense, can not be at all. Only the optimists under us (to which I count myself) consider that for a philosophical high-flowness, a despair-step considering of a great crisis. We hope that the staggering of conceptions and opinions means only a vehement process of change, which will finally lead to a something better thing as the confuses formula-lumber which to day surrounds our object.“

Broglie [6], who advocated out of despair for a time the hypothesis of probability, wrote 1953 (translated): „Rather one should get the danger out of way, that a too tight belief in the statistical character of quantum theory, this finally makes sterile.“

If one can proof something not or not quantitatively, and he will carry on nevertheless his train of ideas, so he had to disregard over something. To compare with Copenhagen-interpretation, where is disregarded all things with the indescriptness, and this disregard is only camouflaged philosophically and mathematically. The believers of a teaching-opinion disregards over the same, they form a conservative block of the convenients. By the non-believers however every author disregards over an other thing as it is shown in this paper.

This paper may not propagate to fail from one extreme in the other. As historically is shown, abstractions are necessary to make possible a progress in physics. Fateful was only that indescriptness was exhibited as a physical principle and not as a preliminary attempt of despair as demanded by Schrödinger and Broglie.

2. Vortex hypotheses out of the time before the 20th century

Descartes [7], described 1644 refraction of light at oblique incidence in a denser medium with the earlier stopping of rotation of the light particles in one side as in the other one. The retina perceived not only the pressure of the light particle but also the rotation as colour. Besides he advocated vortex hypotheses in celestical-mechanics. By the ancient Greeks already Anaxagoras (501-428 B. C.) advocated this. Malebranche [8] set 1698 at the place of hard pellets for light particles little vortices of subtilized matter which are light to compress.

Vortex-hypotheses for interpretation of magnetism before Faraday and Maxwell described Hoppe [9]. Interesting is, that Gilbert described magnetism as given vortex-force, he considered only the attraction, repulsion results in turning. So gravitation had no special position. Probably Faraday gave up this for preservation the analogy to electricity.

Cullagh [1] gave already a theory of light which used only rotor components of the electromagnetical field and which corresponded to the later electromechanical theory of light by Maxwell. The both first Maxwell's equations written in modern form, run:

$$\mathrm{curl}\ E = -\,dB/dt \qquad \text{and} \qquad \mathrm{curl}\ H = I + dD/dt.$$

That means, that at every point of a temporal changeable electromagnetic field, as well the electrical as the magnetical field are rotating. Maxwell [10] respected this in the paper in which he developed the fundamentation for the equations, named to him, by molecular vortices as innumerable vortices which fill the whole space. The word 'molecular' was used in the form as we now use the word 'molecular motion'. Headings of this paper run (retranslated): „Application of theory of molecular vortices - on the appearance of magnetism - on electrical current - on statical electricity - on the action of magnetism on polarized light“. The axis of molecular vortices form the force-lines. Maxwell tried to compare the molecular vortices with currents of fluids. Between neighbouring molecular vortices then are necessary intermediate-wheels or friction-rolls. These friction-particles involve the electric current, that pressure involve the voltage and the electrotonic states by Faraday. Maxwell refused the theory of action at a distance and advocated the proximity theory by Faraday. In his later papers Maxwell did no more use these mechanical analogies which he could not carry through quantitatively. But he set the conception of field in the fore-ground, molecular vortices set further the basis for magnetical quality of matter. He considered light as an electromagnetical disturbance.
Maxwell felt what we know to day: Matter consists of elementary-particles, atoms, crystal-lattices and other structures, at which all particles have rotating, rotatorable, or shiftable parts, which are to influence by electric and magnetic fields. Maxwell's equation extrapolate Maxwell's molecular vortices to rotating points. Faraday's electronic states reported Nieke [11].

In the middle of the former century Trait as experimentist and Thomson as theoretician are engaged in vortex appearances, especially with smoke-vortices. The (Helmholtz's) vortex-sentences were on principle developed by Thomson. Helmholtz [12] published this in a more elegant and clearly

arranged form. Out of the analogy of hydro-mechanical and electromagnetical problems they inferred that to every hydro-dynamical problem corresponded an electromagnetic problem. Special about vortex-atoms wrote Thomson [13], at which he started with vortex-rings. Later asked after that, he said: „It was a dream“

Off the middle of the 19th century light was valid uncontested as wave (the follower of Newton died in the meantime), and that as oscillation of ether, at which the ether had to set the drag force. The constancy of direction of polarization made difficulties at Young's interpretation with light as transversal-oscillations. Transversal-oscillation occur in solid bodies but not in a gaseous-medium or even in vacuum. To give the ether, which should fill the whole universum, the for that necessary qualities, Thomson [14] demanded a rotating, quasi-statical ether. Lorentz [15] discussed this problem in detail.

Hicks [16] extended the model of vortex-rings with a rotation in direction of the ring-formed vortex-tube as spiral or gyrostatic vortex-aggregate. To that he took no relation to the structure of matter

Hertz succeeded with introduction of the by him named Hertz's vector, a with a curl-term defined abbreviation, that the curl-operator appears not open in the equation of electromagnetic without charges and poles. Hertz [17] started from the changeable field where closed field-lines are formed, whilst in every half-period is detached a vortex, which is opposite to that in the foregoing period. Closed vortex-lines form always a vortex field, but Hertz interpreted the closed vortex-lines, corresponding the conception of his time, with waves, and the so out of Maxwell's equations won formula is named as waveequation. The curl also of this field is unequal zero in every point of the space, but this is nowhere noted.

Duhem [18] divided between the English physicists as Faraday, Maxwell and W. Thomson as comprehensive thinker, who are starting from conceptions, and seek for models. The contrast form the French or German physicists as profound thinker as Laplace, Fourier, Gauß, and F. Neumann. They set instead of conception on the reason, they are accessible to abstractions and satisfied with formal formulas. Interesting is the reaction on the above stated demand of Maxwell's equations for rotation of the field in every point of space. Maxwell reacted with molecular vortices, the opposite side did not put out this, for a rotation of field in every point of space is inaccessible for the reason. Besides, the division by Duhem in nationalities did not prove true, everywhere are comprehensive and profound thinker.

3. Vortex hypotheses in the first half of the 20th century

With mechanical vortices Wood [19] could show interference appearances. Northrup [20] showed the appearances of reflexion and refraction with mechanical. vortices too.

For the structure of matter with and without vortex-hypotheses there are now to respect the quantum qualities of radiation. Bohr [21] tried first with his atom model still a descriptive interpretation whilst he carried over the motion of planets on the atom, where negative electrons revolve round the positive atom-nucleus. The orbits had to fulfil quantum-conditions. In many cases there resulted apparent invincible difficulties. Here is to point to the electron with rigid rotating point-, plane-, or volume-charge, upon which reported e.g. Hönl [22]. Not only the famous factor 2 between mechanical and magnetical moment was the problem, but also the considerable transgress of velocity of light at the rotation.

Consistent the attempt of interpretation should be follow with deformable media. Therewith should come an avalanche of mathematical difficulties in the calculations, but authoritative was supposing that vortex-dynamics presupposed the knowledge of structure which was not present. For the atom there was discussed a structure, but for elementary-particles at that time no structure was discutable. So Bohr [23] believed to master this problem more convenient with the thesis of exclusive probability-statements and the with it united indescriptness for quantum-processes. So it was not necessary to use the whole mathematical expression for deformable matter, but one could introduce aimed mathematical supplements without need to establish this, if only the wished results are to obtain.

Stark [24] advocated off 1907 the standpoint that the electron has a ring-formed axial structure. Electromagnetical energy streams once ring-formed round an axis, in direction of a vortex-filament of a ring-vortex, and then as second cyclical round this filament, as by Hicks [16]. Thereby this ring is lying at hydrogen around the positive nucleus, the diameter of the ring is variable ever energy. For Bohr considered the electron on principle as not localizable but as smeared charge, so both

conceptions are not at all so different. At the carbon after Stark the four valence-electrons are ordered tetraedric to the nucleus, where the centres are stationary. The rings are outside the nucleus and outside the two inner electrons. With Bohr's model the tetraedric bond is descriptive not explicable. Stark [24] could obtain, also through declaration of experiments, which proof the axiality of atoms, no acknowledgement. Kossel [25] confirmed the descriptness, but pointed out that every acceptance of resting electrons demands additional strange forces, which admitted arbitrariness.

Sommerfeld [26] considered possibility of transitions and uncertainty relation in modern physics as examples of descriptness. Stark [27] meant to this (translated): „The descriptness of modern physics consists of their indescriptness.“ Lenard [28] supposed as monomeric units of matter 'dynamides', which only trifling fill the space. A rotating pair of quanta he considered as simplest 'dynamide'. By him this picture approach the vortex-atoms by Thomson [13].

Einstein [29] wrote (translated): „The ever inconceivable on the world is their conceivability. That the setting of a real outer world without every conceivability was senseless, is one of the great knowledges by Immanuel Kant.“ And: „If here is the talking about ‘conceivability’, so this expression is meant here in his modest meaning. It means: By creating of general conceptions and relations between this concep tions and by any fixed relations to produce between conceptions and sense-experiences of any order. In this mind the world of our sense-experience is conceivable, and that it is, is a wonder."

Mie [30] wrote in his theory of matter (translated): „The basis-conception of my theory is, that also the inner of electrons appears electric and magnetic forces. ... , where the ether took a quite definite state, which we named as electrical charge. ..., a peculiar behave of the ether, that only at singular places win a remarkable strength, and that an appearance of vortex-places in the magnetic field ...“

Wiener [31] tried to develop a kinematic basic-law in which he would include general currents. Newton's mechanic was completed through a vector-product (as force, which effects perpendicular to its direction). He accepted an ether, which was not took amiss to the author of the famous Wiener-experiment where he believed to proof ‘standing light-waves’. Out of this he concluded as monomeric-unit a screw-vortex, which he named ‘archon’. For elementary-particle then are meeting right- and left-archons. Lichtenecker [32] described in his obituary on Wiener that's despair, that him did not succeeded quantitatively the performance of his ideas.

Lorentz [33] wrote (translated): „Conceive we an electrical force as consequence of the velocity of ether, so we have to introduce, as already marked, a permanent to- and off-stream of ether in relation to ether, during we regard indeed at the conductor no change. ... The electrical displacement then is a rotation round the force-lines in the suited sense. ... If we attach in every point of space a vector, which declare the direction of rotation in this space, and if we construct the system of curves, for which these vectors state the direction of tangents, so are to find the so called vortex-lines with that we can form, because of the solenoid distribution, also vortex-tubes.“ Einstein [34] wrote that it was the merit of Lorentz to use the electro-magnetic field of the empty space, or as at that time was said, in the ether. By Einstein should put equal here ether as empty space.

Schrödinger [35] concluded out of a periodic summand of the wave- equation for the electron by Dirac to a trembling-motion (Zitterbewegung) of the centre of gravity. For it is to respect that Schrödinger did not believe in the dualism of wave and particle but hoped to describe matter with waves (true with eigen-frequencies) with the wave-packet as particle. With that he had avoided to speak of rotation or vortex.

Emde [36] emphasized that in usual use of speech the word vortex is not used uniformly, also the whirlpool is named as vortex. Therefore Emde offered for the conception of the physical-mathematical rotor or curl the denotation 'quirl' . Last it is to mark that the statement of a frequency permitted always two interpretations, that as swing and that as rotation, both are exhibitable by the same periodical function.

In this time laid the start-successes of Heisenberg-Bohr's quantum-theory at special problems, above all the mathematical description of the spectra. To this time raised also the opponents to the Copenhagen-interpretation, some of them are quoted in the 1th section. But they could not asserted successfully against the mathematical formal successes, for they themselves could not show successes in this field.

4. Avoidance of vortices in Heisenberg-Bohr's quantum-theory

Goudsmith a. Uhlenbeck [37] considered the spin, which was discovered first at the electron, as inner rotation. Pauli [38] refused with right a simple rotation and for he advocated the thesis of indescriptness in quantum-processes of Copenhagen-interpretation, he introduced the spin as formal magnetic- or spin-quantum-number. Although spin means spin, turn, whirl - nevertheless should be rotating nothing by this definition. Fateful was that Pauli denoted electron and the electron with 180° turned perpendicular longitudinal axis of magnetic moment (or spin) with spin +1/2 and -1/2, instead to reserve the opposite sign for the opposite direction of rotation. But the positron was first discovered 1932 and then ensued no correction, what has far reaching negative consequences. This is discussed by Nieke [39], with the argument that a right-screw becomes no left-screw by a turn 180° perpendicular to longitudinal axis. For a simple rotation of elementary particles was not thinkable, so it should be a rotation- or vortex-aggregate where only inner rotations result. However, Heisenberg [40] concluded for the photon with structure two parts with spin and antspin, therefore the spin as spin-, rotation- or vortex-aggregate, what Nieke [41] carried out.

5. Vortex hypotheses in the 2nd half of 20th century in hitherto form

At the end of the first half of the 20th century there asserted the Copenhagen interpretation as opinion of the plurality in consequence of their formal mathematical successes and their convenient handling as by Einstein [4] described.

Vortex hypotheses for structure of matter are from some authors advocated as hitherto. The papers of this group appeared only published by the author or in only for that purpose founded periodicals. And surely many gave up because of difficulty in publication.

Stark [42] showed experimentally that light is deflected in an inhomogeneous electrical field, even yet measurable for him, if the plane of polarization is standing perpendicular to the field axis. He explained this as interaction of vortices of light as circular current of electric energy with the electric field.

Ehrenhaft [43] poured fine powder of most different substances in gases or vacuum and then he irradiated them intensive with light. At this he observed a positive or negative photophoresis, a motion in or opposite the direction of light and rotations too. In homogeneous electrical fields he observed the electro-photophoresis, positive and negative tremble-motions, which cause corresponding screw-paths. In homogenous magnetical fields yielded the magneto-photophorese with N- and S- motions and regular screw-motions. Finally he observed the gravitatio-photophorese with up and down, rotation- and screw-motions round the plummet or the transversal photophorese. Powders are no ideal research-objects and nevertheless with many publications yielded no everywhere universal dependencies. But surely is, as Ehrenhaft accented explicitly, that the screw-motion is not explicable with help of Lorentz-force, for that the charges have to carry the ten million fold charge. He accepted to explanation magnetic charges as already to this time Dirac [44] demanded as point-poles.

Kraft [45] emphasized that the experiments of Sagnac and Michelson refute only the dragging ether, but he confessed that the ether never was proofed directly. He accepted the ether as 'viszid', as inert but frictionless. Remarks as (translated): „We may formulate the conception of ether not too materialistic, but the medium which consists as well matter as spirit", conductived surely not his arguments by all readers. As basic-element he used ether-vortex-rings, which are building up as smoke-vortices. Matter is building up out of different ether-vortex-rings, at which Magnus- and Venturi-effect cause the interaction. Atoms and atom-components he thought composed of vortex-rings with different sense of rotation, there are many similarities with the composition of quark and antiquark.

Bauer [46] built up on vortices with torus-structure, which correspond to Stark's vortices, where the vortex-ring has yet a screw-structure. He also thinks the matter composed out of these torus-formed vortices.

Martin [47] criticized all four theories of light, he inferred (translated): „The light-particle is no simple slinged projectile-particle, but a thing with an independent mechanism of run, which must be made possible by its special building." And: „". . . The two ether-apartments travel to the direction of run, . . ."

In this context is to call attention to the nucleus-induction, where the atom-nuclei are considered as gyro-tops which executes precessions-motions in magnetic-field.

6. Vortex-hypotheses leaning upon the theory of quanta

Models of photons:

There are two different acceptances about that's basic-units.

1. The circular polarized photon as basic-unit.

Nowak [48] gave as model of a photon a screw-vortex. Similar models offered Christiansen [49] and Shewandow [50] without to mention the conception of vortex. Honig [51] described the photon as toroidal vortex. At the circular polarized photon the E-vector is rotating perpendicular the direction of propagation with the frequency f, it describes a screw-line round the propagation-direction with the screw-rise of one wavelength. For linear polarized photons find together by these authors a right- and left-photon as a pair. At the transformation of polarisation by a quarter-wave-plate this occurrence is improbable, from where should come suddenly the other photon? Ehrensprenger [52] supposed that at linear polarized photon the windings are squeezed as between two walls. But here seams the return-process improbable, for the windings are opened again.

2. The linear polarized photon as basic-unit

Heisenberg [40] described the photon consisting side to side laying fermion and antifermion with spin as isospin. The quark-theory described the photon, as all spin-1-particles, consisting as quark and antiquark. Hughston [53] exhibited the photon as twistor-pair, Lewit [54] as double-winding and Nieke [55] as electro-magnetic vortex-pair. In this model the circular photon rotated as whole photon round the propagating-direction.

In agreement with both models the mechanical angular-moment is proved mechanically at the circular polarized and not at the linear polarized light.

Models of electrons:

Hönl [22] discussed many models of electrons with rotating point-, plane-, and volume-charges. He accented that the electron shall not conceived as rigid body, but he did not respond to deformations. The charges are presupposed and not as in some vortex-hypotheses caused on rotating electro-magnetic fields. Jehle [56] described the electron as superposed elementar-loop-forms. Pekeris [57] declared this as hydro mechanical model with stationary circulations. He inferred this out of Maxwell's equations, the electron was held together through Coulomb's forces. He concluded this with Hick's vortices [16]. Mack a. Petkova [58] remarked that the quark model is describable with condensed vortices. Predergast [59] discussed magnetical fields as torodialic flowing in equilibrium analogue Hick's vortex. Nieke [60] started from the simplest form of pair-formation or positron-annihilation with

$$2 \text{ photons} \Longleftrightarrow 1 \text{ electron} + 1 \text{ positron}$$

In preservation of spin is to doubt. With the photon (γ-particle) as vortex-pair results as transformation for the electron and positron the structure of an electromagnetic right- and left- vortex-twin (two vortices of the same rotation-direction, which round another in the same direction).

$$2 \text{ vortex pairs} \Longleftrightarrow 1 \text{ right vortex twin} + 1 \text{ left vortex twin}$$

This is a reorganize of four vortices in every side. The vortex-twin has the right symmetry with a polar axis and is stable in rest too.

Hither would belong the application of vortex-dynamics in supraconduction, suprafluidity and tunnel-effect. This application establish on the quality of vortex-pairs, which move rectilinear, or better they drive another mutual forward. Electrons and helium-atoms form vortex-pairs, if they put in order side by side with opposite spin by pairs and as result of their self-dynamics they deliver the above effects.

7. Out of diffraction experiments inferred vortex-hypotheses

Sommerfeld [60] accented, that the influence of two vortices results the velocity, the first derivation to time, and not the acceleration, the second derivation to time. Sommerfeld [61] could write the wave-equation and the Schrödinger-wave-equation, that they differ, besides the factors h and i, that containing the classical wave-equation the second and the Schrödinger-equation the first derivation to the time. With it Sommerfeld had unconsciously proofed that the Schrödinger-equation can be a formula of vortex-dynamics. For the Schrödinger-equation or the equivalent Heisenberg's matrix-mechanics are belonging to Heisenberg-Bohr's theory of quantum, so should be their successes a result of application of vortex-dynamics. With the possibility of Schrödinger-equation to be a

formula of vortex-dynamics is given a further hint, that vortex-dynamics have a hitherto undervalued importance. For in the meantime (about 1960) elementary-particles can have a structure, so pointed all on a vortex-structure. It is to direct to the Einstein-de Haas effect and the Barnett effect where mechanical rotation was proved at magnetize. So should be the spin no more a formal quantum-number, but no simple rotation but a vortex-aggregate.

By Nieke [55] a mechanism of diffraction with help of vortex-dynamics is offered, but this is already described in part I section 6, page 31.

Ricke a. Kramer [62] asked the question) how the Taylor-vortex find its size. They conceive that as phase-equilibrium of diffusion with respecting the friction with Reynolds-number.

8. Vortex-interpretations in scope of quantum-theory

In the last third of 20th century are find vortex-hypotheses which tried to interpret this mechanism vividly. As example wrote Davis [63]: „Vortices are filaments of topologically trapped false vacuum, appearing after spontaneous symmetry breaking in a gauge theory where the manifold of degenerate vacua has non-trivial π_1 homotype. In other terms, a puddle of superfluid helium had dimples.“ But that is no descriptness for the indescriptness, but only their misleading popular adornment.

About spin-models reported Moreal [64] in sense of Copenhagen-interpretation. He pursued above all group-theory, where he also used turning-groups. By Hughston [53] the twistor is exhibited through an algebraic geometry in the complex space by solutions of differential equations which lead to the twistor-equation. The twistor has a spin or antispin.

Here is to direct to the string-theory. Strings can have a spin, can be open and closed, supposed as chord-, torus-, loop-, right-, and left-forms. Thereby limited spheres can have another symmetry, what is named as supergeometry or supersymmetry. Superstrings are described with rolled up dimensions. Corresponding the aim of this paper, the strings were to bring in relation with vortex-filaments.

In a new phase came this as Chern and Simons [65] published on characteristic group-theories without a hint to application. As Chern-Simons invariant is designated the statement J(s) = I(s) mod 1. They used Lie- and Weil-groups which allow applications in physics, for they based on differentiability, turnings, ring- and fibre-structures. About first application reported Chern [66], this was the symmetries of spectral-lines. But soon there were found physical applications. The Chern-Simons invariant or -term were formed in form of path-integral over rotations or vortices or as vector-product to describe an effect perpendicular to the both vectors. It are published extreme numerous papers which used formally the Chern-Simons invariant, they all to quote is no room. These refer also quantum-field theory where the electron is postulated (to consider the magnetic moment of electron) with a coupled magnetic field-tube as quasi-particle, which should show the vortex-field. Formally described are also particles with charge, particles as solitrons, gauge theories, relations to Schrödinger-equation and to quantum-hall effect and much more.

To the here interesting subject shall be quoted Weller [67] and Guadagnini [68]. Guadagnini wrote: „The result (the magnetic field of Chern-Simons vacuum expectation) has a simple interpretation. The exponent in the expression contains the circulation along one closed path, say C_1, of the magnetic field generated by the second wire. This quantity is precisely the energy gain ε of an imaginary magnetic monopole moving along C_1 in the presence of the magnetic field generated by C_2. For each 'winding' of the monopole around C_2, the energy increases by a definite amount which, in our units, is given by $\varepsilon = -2\, e_1\, e_2 (2\pi/k)$. For arbitrary non-intersecting closed paths C_1 and C_2 the volume of the expression (called the Gauss integral) is an integer representing exactly how many times C_1 'wins' C_2.“

9. Vortex-hypotheses for completion quantum theory

Nieke [69] and [70] pointed to the fact, that Bohr cold not consider in his atomic-model the magnetic moment of electron, for it were not discovered. As it was discovered in the year 1925, Bohr already had committed himself that the atom could be classical not to calculate. Nieke [69] considered in Bohr’s atom-model the magnetic moment of electron. With the structure of electron as electro-magnetic vortex-twin the magnetic moment was interpreted as vortex-propelling. This is necessary to bring the electron as electromagnetic vortex-twin in equilibrium. The circle electron results so the

magnetic field which is named magnetic moment-sheet. With consideration of magnetic moment of electron will be reach the same as with the formal consideration of Chern-Simons term.

Nieke [69] called attention to Einstein's assertion that Heisenberg-Bohr's quantum theory was an incomplete theory. With the necessity of introduction of a new term is proved that Einstein was right, for it are missing a sufficient consideration of vortex fields for already Bohr had not considered the magnetic moment of electron. About the nature of incompleteness Einstein had not expressed themselves, besides it is not certain that this is the only incompleteness.

With consideration of the magnetic moment of electron and its vortex-field or the application of Chern-Simons term was do an essential contribution for vortex structure of matter and simultaneously confirmed the opinion of Einstein about incompleteness of Heisenberg-Bohr's quantum theory.

Classic mechanics and electro-dynamics are continuum-theories which are not suited for description of quanta. They resulted there as singularities or as described in section 2 as rotations in every point of space. in every case are missing fundamental knowledges which lead compulsorily to creation of quanta, known Maxwell's theory does that not and Bohr's theory give only formal statements. About Planck's quantum of action and elementary-charge is missing every cognition. Nieke [55] supposed a statement in creation of photons with structure and field. According this paper should be tried to find the solution by combination of electro- and vortex-dynamics.

With it the dream of Thomson [13] (Lord Kelvin) could be come true after 100 years. For this first should be worked on vortex-pair and -twin with help of vortex and electro-dynamics. Then should be examined under which conditions the electromagnetic vortex-pair is only stable with the energy $E = h f$. For the electromagnetic vortex-twin should be demand as stability elementary charge and electromagnetic moment as magnetic vortex-propelling.

Literature IV

[1] J. Mac Cullagh, The collected works of J. Mac Cullagh. Dublin, London 1880; quoted from A. Wangerin u. W. Wien in: Encyklopädie d. math. Wiss. Bd. V, 3 H. 1, S. 61 u. 99. Teubner, Leipzig 1909.

[2] N. Bohr, Atomphysik und menschliche Erkenntnis I. Die Wissenschaft Bd. 112, Vieweg, Braunschweig 1964, S. 5
Atomic Physics and Human Knowledge. Wiley, New York 1958.

[3] W. Heisenberg: Physik und Philosophie. Ulstein Buch Nr. 249, Berlin 1959.
Physics and Philosophy. Harper & Brothers, New York 1958.

[4] K. Przibram (Hrsg.), Schrödinger, Planck, Einstein, Lorentz, Briefe zur Wellenmechanik. Springer, Wien 1963, S.29

[5] K. Schrödinger, Was ist ein Naturgesetz? OIdenburg, München 1962, S. 102-103.

[6] L. de Broglie, La Physique quantique restera-t-elle indéterministe? Gauthier-Villars, Paris 1953; Phys. Bl. **9** (1953) 488-97, 541-8, quotation 547.

[7] R. Descartes, Principia philosophiae. Amsterdam 1644.
Übers. A. Buchenau: Die Prinzipien der Philosophie. Philos. Bibl. Bd. 28 Hamburg 1908; Philos. Studientexte, Akademie-Verlag, Berlin 1965.
The Philosophy and Works of Descartes. Transl. E. K. Haldane, Univ. press. Cambridge 1911, 1931.

[8] N. Malebranche: quoted by W. v. Goethe: Die Schriften zur Naturwissenschaft. Hrsg. Leopoldina, Bd. 6, Böhlau, Weimar 1957, S. 206.

[9] M. L. Hoppe, Die Abhängigkeit der Wirbeltheorie des Descartes von W. Hilberts Lehre vom Magnetismus, Diss. Halle 1914.

[10] J. C. Maxwell, Phil. Mag. (4) **21** (1861) 161, 218, 338; **23** (1862) 12, 85.
The scientific papers I quotion p. 451, Cambridge 1890;
Hrsg. L. Boltzmann, Über physikalische Kraftlinien. Ostwald's Klassiker Nr. 102, Engelmann, Leipzig 1898.

[11] H. Nieke, Newtons Beugungsexperimente und ihre Weiterführung. Halle 1997, Comp. Print 1 Arbeit 18;
(Vorhanden in vielen deutschen Universitätsbibliotheken)
Newton's Diffraction Experiments and their Continuation. Halle 1997, comp. print 3, paper 18.

(Available in some university libraries)
[12] H. Helmholtz, J. angew. Math. **55** (1858) 25;
Ges. Werke Bd. 1, Barth Leipzig 1882, S. 101.
[13] W. Thomson: Mathem. and Phys. Papers. Vol. III, Art. 99, p. 442, Univ. Press., London 1890.
[14] W. Thomson, Proc. R. Soc. Edinburg IV (1869) 94; Mathem. and Phys. Papers Bd. IV 1.
[15] H. A. Lorentz, Weiterbildung der Maxwellschen Theorie, Elektronentheorie. In: Encykopädie der math. Wiss. 5. Bd., T. 2, S.145-280, Teubner, Leipzig 1904-1922.
[16] W. M. Hicks, Phil. Trans. Roy. Soc. London, Ser. A **192** (1899) 33-100.
[17] H. Hertz, Ann. Physik (III) **36** (1889) 1;
Ges. Werke Bd. II, Barth, Leipzig 1892, S. 147.
Electric Waves. Transl. D. E. Jones, Macmillan, London 1893.
[18] P. Duhem, Théorie physique, son objet et structure. Paris 1901.
The Aim and Structure of Physical Theory. Transl. P. P. Wiener, Univ. Press Princeton 1954.
Übers. F. Adler: Ziel und Struktur der physikalischen Theorien. Barth, Leipzig 1908, S. 67-121.
[19] R. W. Wood, Nature **63** (1901) 468.
[20] E. F. Northtup, Nature **88** (1912) 463.
[21] Die ersten zehn Jahre der Theorie von Niels Bohr über den Bau der Atome. Naturwiss. **11** (1923) Heft 27, S. 535-624.
[22] H. Hönl, Ann. Physik (5) **33** (1938) 565-583; Erg. ex. Naturwiss. **26** (1952) 291-382.
[23] As [2].
[24]. J. Stark, Die Physik der Atomoberfläche. Hirzel, Leipzig 1940.
[25] W. Kossel, Valenzkräfte und Röntgenspektren, Springer, Berlin, 1924, S. 11 u. 49.
[26] A. Sommerfeld, Über die Anschaulichkeit in der modernen Physik. Unterrichtsblätter Math. Naturwiss . **36** (1930) 161
[27] J. Stark, Über den Dogmatismus moderner Theorien in der Physik. Unterrichtsblätter Math. Naturwiss. **36** (1930)) 303.
[28] P. Lenard, Ann. Physik (4) **12** (1903) 711-744.
[29] A. Einstein: Out of my later years. Phil. Lib. New York 1950;
Aus meinen späten Jahren. D. Verl. Anst. Stuttgart 1979, S. 65-66.
[30] G. Mie, Ann. Physik (4) **37** (1912) 511, Zit. S. 512, 514.
[31] O. Wiener, Abh. math.-nat. Kl. Sächs. Akad, **33** (1921) No IV .S. 1-87;
Ber. math.-nat. Kl. Sächs. Akad. **75**(1923) 132; **76** (1924) 170.
[32] K. Lichtenecker, Phys. Z. **29** (1923) 77.
[33] A. H. Lorentz, Vorlesungen III, Aethertheorien und Aethermodelle. Akad. Verlagsges. Leipzig 1928, S. 44-63.
[34] A. Einstein, A Selection of Extracts from the Writings and Speaks of A. Einstein. Amsterdam 1934;
Mein Weltbild. Hrsg. C. Seelig, Ulstein Buch Nr. 65, Frankfurt M., Berlin 1965, S. 31.
[35] E. Schrödinger, Sitzungsber. preuß. Akad. Wiss. Berlin, Phys.-math. Kl. 1930, 418-428.
[36] P. Emde: Quirlende Felder. Samml. Vieweg H. 121, Braunschweig 1949.
[37] G. E. Uhlenbeck u. S. Goudsmith, Naturwiss. **13** (1925) 953.
[38] W. Pauli,. Aufsätze und Vorträge über Physik und Erkenntnistheorie. Vieweg Braunschweig, 1961, S. 120-146 (Nobel-Vortrag 1946);
Z. Physik **31** (1925) 373, 765.
Collected and Selected Papers. New York 1964.
[39] As [11], paper 14.
[40] W. Heisenberg, Introduction to Uniform Field Theory of Elementary Particles. Interscience, New York 1966;
Einführung in die einheitliche Feldtheorie der Elementarteilchen. Hirzel, Stuttgart 1967, S. 116.
[41] As [11], paper 12 and 14.
[42] J. Stark, Z. Phys. **133** (1952) 504, **136** (1953) 221.
[43] F. Ehrenhaft, Acta phys. austrica **4** (1951) 461-488.
[44] P. A. M. Dirac, Phys. Rev. **74** (1948) 817.
[45] C. F. Kraft,: The Ether and his vortices. Washington publ. by the author 1953;
Übers. O. C. Hilgenberg: Der Äther und seine Wirbel. Schikowski, Berlin 1952.

[46] H. O. M. Bauer, Die Torusstruktur einiger Elementarteilchen. Buchhandlung Franz Wolf, Kiel 1965.
[47] W. Martin: Durch Grundlagenforschung zu neuen Erkenntnissen über das Wesen des Lichtes und zu einer vollkommenen Lösung des Lichtproblems. Turm-Verlag, Bietigheim/Würtemberg 1953.
[48] W. Nowak, Neue Physik (Wien) **1** (1959) 56; **4** (1964) 120.
[49] J. A.. Christiansen, Mat. Fys. Medd. Dan. Vid. Sesk. **37** (1968) 1.
[50] N. D. Shewandow, Die Polarisation des Lichtes. WTB 44, Akademie Verlag, Berlin 1973.
[51] W. M. Honig, Found. Phys. **4** (1974) 367.
[52] J. Ehrensprenger, Energien im Kosmos. Vogel, Winterthur 1988, S. 59.
[53] L. P. Hughston: Twistor and Particles. Lecture notes in physics Bd. 97, Springer, Berlin, Heidelberg, New York 1979 p. 102.
[54] L. S. Levit, Lett. Nuovo Cimento **21** (1973) 222.
[55] As [11], paper 12.
[56] H. Jehle, Phys. Rev. (3) D **11** (1975) 2147.
[57] C. L. Pekeris, Proc. Natl. Acad. Sci. USA **72** (1975) 2037.
[58] G. Mack a. V. B. Petkova, Ann. Phys. (New York) **125** (1980) 117.
[59] K. H. Predergast, Astrophys. J. **126** (1956) 498-507.
[60] A. Sommerfeld: Vorlesungen über theoretische Physik, Bd. II Mechanik der deformierbaren Medien. Akad. Verlagsges. Leipzig 1945, S. 155.
[61] A. Sommerfeld: Atombau und Spektrallinien. Bd. II, Vieweg, Braunschweig 1960. Gleichungen (1.5) - (6.9a).
Atomic Structure and Spectrallines. Methuse, London 1923, 1930, 1934.
[62] H. Ricke u. L. Kramer, Phys. Bl. **48** (1992) 17; Europhys. Lett. **14** (1991) 433.
[63] R. L. Davis: Twisted Vortices, String Solitrons, and World Sheet Instantons. Nuclear Physics B **294** (1987) 867-876.
[64] H. Moral, Classical, Discrete Spin Models: Symmetry, Duality and Renormalization. Lecture notes in physics, 214, Springer, Berlin, Heidelberg, New York, Tokyo 1984.
[65] S. S. Chern a. J. Simons, Proc. Nat. Acad. Sci. USA. **68** (1971) 791;
Ann. of Math. **99** (1974) 48-69. = S. S. Chern, Selected papers Vol. 1. Springer, New York 1980, paper 103 p. 444-465.
[66] S. S. Chern, Complex Manifolds without Potential Theory. Second edition, Universaltext, Springer, Berlin u. a. 1995, § 7, p. 148-154 u. 157.
[67] W. Weller, Phys. Bl. **52** (1996) 121-4.
[68] E. Guadagnini, The Link Invariants of the Chern-Simons Field Theory. De Gruyter, Berlin 1993, p. 5.
[69] As [11], paper 17.
[70] As [11], paper 20.