Johannes F. Lehmann

Force of Gravity/Power of Labour—or: Heaving Stones

Since the dawn of human interaction with their environment and the rock surrounding them, stone and its weight has been measured by the correlation between a labour-power and a force of gravity. In order to heave the stones of the Egyptian pyramids (2620–2580 B.C) to their final position in the structure, in order to erect the stone stelae at Stonehenge (2500–1700 B.C) or in order to build the cyclopean wall of the early Greek palaces like that at Mycenae (around 1350 B.C), a gigantic amount of man and animal power was required. Even today, the numbers are still only approximate. In 1586, it would still take 102 days to move a 354 tonne, 25-meter-long obelisk 256 meters. The same obelisk had previously been transported from Alexandria to Rome in the year 38 A.D. For the lifting and setting down of that stone alone, 75 horses and 907 workers were needed.[1] The gravitational force of the stone needed to be offset by the labour-power. The Latin word for work: "labor," with its Indo-Germanic root "lab-," can, when used as the verb "labi," be translated as a back and forth motion in relation to the bearing of a load of weight.[2]

Despite this, the concept of gravitational force and labour-power are specifically modern concepts. Emerging first in the 19th century in a specific and mutually linked coupling, the combining of the force of gravity and labour-power became the foundation, not only for defining a concept of physical force, but also for the conceptualisation that the labour-power of human and

1 See Veronica Biermann: Schwebende Schwere – lastende Leichtigkeit. Schwerkraft und Bewegung in der Architektur, in: Frank Fehrenbach et al. (eds.): Kraft, Intensität, Energie. Zur Dynamik der Kunst, Berlin and Boston 2018, p. 221–245, here page 227. For gravity and weight in art, see also the contributions of David Young Kim (ed.): Matters of Weight. Force, Gravity, and Aesthetics in the Early Modern Period, Emsdetten and Berlin 2013. Also, the remarks on the "Aesthetics of Heaviness" made in Malika Maskarinec: The Forces of Form in German Modernism, Evanston 2018, p. 17–55.

2 Manfred Bierwisch: Arbeit in verschiedenen Epochen und Kulturen. Einleitende Bemerkungen, in: idem (ed.): Arbeit in verschiedenen Epochen und Kulturen, Berlin 2003, p. 8–18, here p. 9f.

animals could be economically useful. How did this coupling emerge? and how did it come to be a pairing of labour and power in the term "labour-power"? It is astounding that the concept of labour-power has had no conceptual historical attention drawn to it, despite becoming, at the latest, only a foundational term for the economy in Marx's Capital, and despite the fact that our everyday life cannot be imagined without it.[3] Alongside this, the virulence of the term in physics and the economy, but also in movement-, sensory-, and nutritional physiology of the 19th century, can only be explained against the foundational transformation in the application of the term during the 1800s. The premise, which I will discuss first, is the migration of the concept of the force of gravity, or rather gravitation in the anthropological reflections and the self-perception of man as a living being of power able to overcome obstacles. Against this background, the concept of "labour-power" can, secondly, be made plausible by blurring the lines between the economy, physiology, physics, and life.

The correlations between gravitational force, labour-power, and the lifting of heavy weights (such as the moving of stone) discussed in the following essay can be illuminated upon through some 19th century texts, insofar as those texts relating to a labour-power speak paradigmatically of the lifting of stone, like many texts published in the second half of the 19th century. Abraham Szontagh's Lecture *Über die Bedingungen der Größe der Arbeitskraft mit Berücksichtigung einiger Hausthiere* published in 1859, argues that the labour-power of man and beast, namely the power to move heavy weights, stems from the interaction between active force and tension force. Here, active force refers to the exercised and expended force such as in the lifting and heaving of a stone. Alternatively, tension force, on the one hand, is the prerequisite for this active force, and, on the other, emerges anew through the lifting of the stone as available tension force which, in the falling of that stone, can then be released as active force:

> "Active force, in whichever form it may appear, whether as warmth, light, electricity or as the moving of a mass, is singular in all of nature and is achieved only through the transference of tension force; just as, in turn, these only arise through the use of active force. By tension force we understand the cause of a quasi latent movement, impeded in its appearance by an opposing force, that is simultaneously perceived as soon as the obstacle is removed. [...] So transforms the active force, that is used for the

3 So, we recognise that the historical dictionary of philosophy as well as the *Geschichtlichen Grundbegriffe* both have entries for the term "labour" but not for a "force of labour." See also Joseph Vogl and Burckhardt Wolf (eds.): Handbuch Literatur und Ökonomie, Berlin and Boston 2019.

> lifting of a stone, into tension force, that, for the time being, is deposited in the stone and through a drop of that same stone, becomes active force once again."[4]

The lifted stone, so to speak, stores energy, or rather power, that was expended through lifting; the stone acts as a store for energy or power. The weight, in turn, produces a labour-power through active force when it falls. What applies to a stone lifted through active force, also applies to the stone itself and its own existence. When the stone is hard, dense, impermeable and heavy, and, with these characteristics, is used to build a fortification wall, it can withstand forces such as wind, storms, conquests, cannonballs etc.[5] This is due to the fact, that the hardness and density of stone is a product of geological forces that built up the stone in the form of heat, movement, gravitation, pressure and time (through so called "exogenic" and "endogenic" dynamics).[6] These have, as it were, then been stored in the stone itself. The hardness and heaviness of stone, something that can repel force, is a product of forces that are stored in the stone itself. According to Hermann von Helmholtz, active force, as that force that brings a weight into movement or that realises movement, is made up of the overcoming of gravitational force and is therefore useable as labour-power:

> "The movement of a mass, in so far as it represents the labour-power, is called the active force of that mass. That word 'active' here, of course, is in no way related to living beings, rather the force of movement should only differentiate from the peaceful state of unchanging existence, in that, for example, the gravitational force is found in a stationary body, which receives a continuous pressure against its foundations, but generates no change in state."[7]

4 Abraham Szontagh: Über die Bedingungen der Größe der Arbeitskraft mit Berücksichtigung einiger Hausthiere, Bratislava 1859, p. 4.

5 See Bettina Marten et al. (eds.): Festungsbau. Geometrie Technologie Sublimierung, Berlin 2012. Rocks understandably vary in hardness, density, and weight, the basis for the classification of stones. Volcanic (effusive rock) are somewhat lighter as the cooled "Plutonite" in the earth, just as granite. Cf. Walter Maresch et al. (eds.): Gesteine. Systematik Bestimmung Entstehung, Stuttgart 2016.

6 Heinrich Bahlburg and Christoph Breitkreuz: Grundlagen der Geologie, Berlin 2017, p. 15–190 and p. 191–347.

7 Hermann von Helmholtz: Über die Wechselwirkung der Naturkräfte und die darauf bezüglichen neuesten Ermittelungen der Physik. A popular-scientific lecture held on the 07th of February 1854 in Königsberg, Prussia, p. 107.

The gravitational force of water is thus used to lift the weight of a hammer. The active force generated in the falling of that hammer is then to be considered as labour-power in the mechanical sense: "The work, which a machine performs, exists in this case when the mass of the hammer is lifted, to the end that the weight will overcome the mass."[8] In other words:

> "Out of this, it is easily apparent that we have to measure labour through the product of a lifted weight, multiplied by the falling space. And so, the mechanics is measured in the act; it calls its labour mass a 'pound-foot' because a pound of weight is lifted a foot in height."[9]

Central for the ascertainment of "labour-power," something that Helmholtz identifies in the mechanical sense as the height of the expenditure of energy and as the overcoming of a weight of any mass, is that gravitational force is transformed into active force. In his text on the law of *The Conservation of Force* Helmholtz writes: "the size of labour, which is gained and used, can generally be expressed as one of a particular height (h) of a lifted weight (m); it then becomes mgh, where g is the intensity of the gravitational force."[10] Labour-power works with and against the resistance of the force of gravity, something which is then also relevant to the economy. The political scientist Lorenz von Stein writes:

> "The mass of force, which should determine a certain material for a particular purpose, must be bigger than the mass of the natural force which the existence of the material opposes to labour. Both masses must, from then on, be known and calculated. And it follows, the more the mass of the gravitational force surpasses the natural forces, the more securely the purpose of the labour will be achieved [...]. Usually, however, the attribution of weight is the foundation of measurement."[11]

Here too is the lifting of weight, the overcoming of a gravitational force, also the basis of determining labour-power.[12]

8 Helmholtz 1854, p. 105.

9 Helmholtz 1854, p. 105.

10 Hermann von Helmholtz: Über die Erhaltung der Kraft. Eine physikalische Abhandlung, Berlin 1847, p. 9.

11 Lorenz von Stein: System der Staatswirtschaft, Stuttgart and Tübingen 1852, p. 143.

12 This also applies for the equivalent of warmth and force, just as Helmholtz formulates: "The amount of heat, which is necessary to raise the temperature of a pound of water one degree on the hundred-part thermometer, entails a force of labour, whereby a pound must be lifted 425 meters; one calls this the size of the mechanical equivalent of heat." Helmholtz 1854, p. 114. A little later, the factor of time effected the development of the term: "The unit of

The Force of Gravity

The fact that the overcoming of gravitational force in the human body is recognised by an upright, vertical position, something that permanently accompanies the body and is a constant reminder of this overcoming of gravity, was an anthropological finding first surmised in the 1800s in the discursive reflections on the erect motion of man. 60% of the muscle mass of the human, as we know today, is so-called "anti-gravitation musculature." "Some 90% of the energy spent by moving is required to lift the legs against the force of gravity and 10% to swing them forward."[13] With age, "the struggle against the force of gravity becomes more and more difficult, until the body finally succumbs to gravitational force."[14]

The view that the erect movement of humans is a permanent expenditure of force against gravity was new in the 1800s. In the history of the Occident, from antique myth to Ovid and Lactantius, up until John Milton, the upright gait of the human was associated with the notion of being made in gods image and the ability to gaze upon the heavens. The locus classicus originates from Ovid and reads: "and while the remaining creatures lean forward and gaze down to earth, so he gave man a heavenly visage, commanded him to watch the heavens and lift his face towards the stars."[15] Being positioned towards heaven is connected, respectively, with the exceptional position of the human being, the quasi human dominion which is exercised over animals: "a creature who not prone / And brute as other creatures, but indued / With sanctity of reason, might erect / His stature, and upright with front serene / Govern the rest."[16] So is it in John Milton's biblical epic *Paradise Lost*. In Hayden's Oratorio *The Creation* we see that "facing the heavens, stands the human being, a man and a king of nature."[17]

Against the background of this tradition is a crucial, even revolutionary transformation. The upright position appeared to no longer be a representation

Labour Force is the foot-pound-second, that is the force of labour, which carries out the labour of a foot pound in every second. A higher unit is horsepower, which is the same as 480 second-foot-pounds." Wilhelm Schrader: Elemente der Mechanik und Maschinenlehre in zwei Theilen. Erster Theil Geomechanik, Halle 1860, p. 294.

13 Hinrich Rahmann: Mensch Leben Schwerkraft Kosmos. Perspektiven biowissenschaftlicher Weltraumforschung in Deutschland, Stuttgart 2001, p. 210.

14 Rahmann 2001, p. 210.

15 Ovid: Metamorphoses. Latin/German, transl. and ed. by Michael von Albert, Stuttgart 1994, p. 84f., p. 11f. For the Anthropology of the upright gait, see also the instructive study from Kurt Bayertz: Der aufrechte Gang. Eine Geschichte des anthropologischen Denkens, Munich 2012.

16 John Milton: Paradise Lost. A Poem in Twelve Books, vol. 2, London 1749, p. 51f.

17 Quote from Bayertz 2012, p. 81f.

of the mental, spiritual and theoretical dimensions of the human, but rather simply the opposite of liveliness and gravity; an issue of the relationship between active balancing forces and the ever present force of gravity. William Paley in his *Natural Theology* (1802) writes:

> "Either the law of gravitation is suspended in favor of living substances, or something more is done of them, in order to enable them to uphold their posture. There is no reason whatever to doubt, that their parts descend by gravitation in the same manner as those of dead matter. The gift therefore appears to me to consist in a faculty of perpetually shifting the center of gravity by a set of obscure but quick balancing actions, so as to keep the line of direction, which is a line drawn from the center to the ground, within its prescribed limits. Of these actions it may be observed, first, that they in part constitute what we call strength. The dead body drops down."[18]

On the one hand, one can say that this statement circulated completely within traditional frames of thought regarding theories of human movement, just as those formulated in the influential, early modern work from Giovanni Borelli *De motu animalium* (1680). A book that was still consulted up until the 19th century for anatomy and physiology.[19] Borelli had described standing and walking as a mechanical problem of shifting the centre of gravity, and analysed movements like jumping in regard to exertion and balance. When Paley speaks of the line which runs from the centre of gravity of the body, all the way down to the ground, he is directly referencing Borelli and his copious corresponding illustrations.[20] Here, on the other hand, the problem surrounding the upright position is described, not solely in regards to the mechanical "centre of gravity" and its displacement, but also regarding the "force of gravity" and the active force of its overcoming as a permanent demand on the human organism's attainment of balance against that force of gravity. This forms the basis of a vital differentiation, one that is also central to the discourse surrounding biology established in the 1800s as well as corresponding concepts of life and life force; namely, the difference between life and death.[21] So when

18 William Paley: Natura Theology. Or Evidences of the Existence and Attributes of the Deity, London 1802, p. 219.

19 See Andreas Mayer: Wissenschaft vom Gehen. Die Erforschung der Bewegung im 19. Jahrhundert, Frankfurt/M. 2013, p. 40.

20 Mayer 2013, p. 62. The work is available in an English translation: Giovanni Alfonso Borelli: On the Movement of Animals, transl. by Paul Maquet, with 18 tables inside back cover, Berlin and Heidelberg 1989. See Plate X for the representation of man's center of gravity through walking and standing.

21 See Hubert Thüring: Das neue Leben. Studien zu Literatur und Biopolitik 1750–1938, Paderborn 2012; also cf. Johannes Lehmann: Energie, Gesetz und Leben um 1800, in:

Paley questions why the living body, that like the dead body is made up of heavy materials, doesn't fall over, so too do the theorists of life force ask why the living body doesn't decompose, but the dead body does.[22] If it cannot be assumed that the natural forces such as gravity or force of attraction are suspended in or by living bodies, one must ask which force would be able to overcome or limit it? Answer: it is life force that ensures that the living human can resist the forces of decomposition, the chemical attraction force of molecules, or even the forces of gravity. Paley generalises and abstracts the power of man in his ability to resist gravity through standing upright and walking. He does this in analogy and against the background of questions surrounding life force. Humans *work* permanently against gravity.[23]

The specific overcoming of mechanical and vitalist "labour," that here is presented as an antagonist to the force of gravity, is characteristic of further debate in the research and theorising of movement. On one side, vitalist physiologists such as Paul-Joseph Barthez, who, even before Paley and in opposition to the merely mechanical theory of Borelli's, tried to validate the specific output of muscles controlled by the principle of life force, as that force which achieves the upright position of gravity.[24] In his *Nouvelle mécanique des mouvemens de l'homme et des animaux*, Barthez analyses the systematic interaction of muscles, joints and the centre of gravity of the body, as an activity of balancing machines: "the upright position of humans, four-legged animals and birds, is caused by the mechanisms of a large number of different parts, where the latter constitutes just as much lifting and balance machines, that, up to now, has been overlooked."[25] Without referring to Barthez, Balzac's the *Theory of Walking*, published it in 1833, is exactly along these lines. Like Borelli, he doesn't want to know why the human falls over or when he loses his balance, but rath-

Maximilian Bergengruen et al. (eds.): Sexualität, Recht, Leben. Die Entstehung eines Dispositivs um 1800, Munich 2005, p. 41–66.

22 Joachim Dietrich Brandis: Von der Lebenskraft, Hannover 1795, p. 17: "As soon as the life force has left the organic body, the same fermentation and decay enters all parts etc. [...]. As long as the life force is present, decomposition does not occur, this life force effects the constituent parts of the organic material more powerfully than the common physical forces of chemical affinity, attraction etc."

23 Bayertz 2012, p. 140, emphasises that in the work of Paley *The upright posture is labour.*

24 Joseph-Paul Barthez: Nouvelle mécanique des mouvements de l'homme et des animaux, Carcassone 1798. Barthez, somewhat like Théophile de Bordeu, to the vitalist doctors of Montpellier and was a contributor to Diderot's and d'Alembert's Encyclopaedia and here author of the article *Force de animaux*, in which he differentiates mechanical and organic force. In contrast to Barthez see Mayer 2013, p. 58. Also, Elizabeth A. Williams: A Cultural History of Medical Vitalism in Enlightenment Montpellier, Burlington 2003, especially the chapter "Barthez and the 'Science of Men,'" p. 255–286.

25 Joseph-Paul Barthez: Neue Mechanik der willkührlichen Bewegungen des Menschen und der Thiere, transl. by Kurt Sprengel, Halle 1800, p. 14.

er why the human "often 'doesn't' fall, as if, by the help of some dark energy, his feet award him with an almost unbelievable "retraction ability."[26] This specific retraction ability is something Balzac traces in his theory, and from this develops a whole social semiotics surrounding force and movement that goes beyond questions of gravity.

On the other hand, Borelli's mechanic remains, up until the 1830s, a concrete point of reference for research into the movement of the human "walking tools," where even the proponents of this line of research describe standing and walking as a form of load-bearing labour.[27] Balzac, in turn, has to acknowledge that is it difficult not to "follow in his footsteps."[28] In Siméon Denis Poisson's *Traité de mécanique*, "walking" is discussed as a "term concerning the size of labour for a moving person or animal with consideration of the load which it bears or hauls on a horizontal or inclined path."[29] Overcoming the force of gravity is designated labour. Poisson writes:

> "If a human carries his weight, which I will identify with *Pi*, to a vertical height (h), above the point from which he set off, so the quantity of the labour needed to bring him to a standing position is identified with *Pih*; but this quantity would give an imperfect idea of the muscle strain that is produced, as well as of the force spent on the whole."[30]

Here too, the perspective of the human body and its movement is described in view of the lifting of the body as being a permanently expended force and as labour.[31] This perspective is also taken in regard to Perception Theory. In his book on the question of why objects appear upright, despite appearing inversed through the retina, Arnold Adolph Bertold fundamentally addresses the orientation capability of the human in space. In this, he makes the force of gravity

26 Honoré de Balzac: Theories of Walking, in: Edgar Pankow (ed.): Honoré de Balzac. Pathologie des Soziallebens, Leipzig 2002, p. 98–154, here p. 116.

27 This perspective of labour is already seen in the title: Wilhelm und Eduard Weber: Mechanik der menschlichen *Gehwerkzeuge*, Göttingen 1836. Cf. to the Weber Brothers also see Mayer 2013, p. 106–122.

28 Mayer 2013, p. 103.

29 See the summary in Weber and Weber 1836, p. 417.

30 Siméon Denis Poissons: Traité de mécanique, Paris 1833. I am quoting the translation from Weber and Weber 1836, p. 419.

31 This model reoccurs in generalised form, no longer merely in relation to the apparatus used for moving, but in regard to all life processes, in the definition of labour, which strives towards determining the human labour force. Gustav Jäger formulates this in his book *Die menschliche Arbeitskraft:* "work is a movement, and every movement is the result of an interference of the position of equilibrium. It stops, as soon as balance is reached." Gustav Jäger: Die menschliche Arbeitskraft (=Die Naturkräfte. Eine volkswissenschaftliche Bibliothek), vol. 25 and 26, Munich 1878, p. 364. More about Jäger below.

known for the possibility of a differentiation, respective of the relations of bodies in space: "we relate 'up and down' to the force of attraction of the earth."[32] Meanwhile, this recourse to gravity is only possible because we notice it in the self-representation of muscular strength: "the muscles and their functions, but firstly through the common sensation that they arouse, are what instruct the direction of the body in space."[33] The plausibility of such an interpretation of the human position and the upright gait as being a permanent overcoming of gravity through labour, in relation to the expenditure of active force, is, from my point of view, supplied by two phenomena that are closely related to each other. Firstly, from the metaphorical transfer of antagonistic gravitational forces into impulse to action and the physical forces of humans. Secondly, from the promotion of a lively self-esteem and feeling of strength as being the source of happiness.

That the forces of gravity and gravitation (and their overcoming) go beyond mere mechanics and into the anthropological self-image of living beings, was evident in the 1800s. Albeit, as a metaphor for energies of the soul, and at the intersection for bodily desires or rather the will (aspiration). The theologising poet Jakob Michael Reinhold Lenz safely takes this idea the furthest. He attempts to give an explanation for the Original Sin, and developed a theory of sexual desire and human freedom in relation to the three Newtonian laws of gravity.[34] Desire (concupiscence) in the sense of gravity and activity (freedom) as the counterforce, play the main role as antagonistic forces. A model is created, that with the plausibility of Newton's Gravitation theory and the conflicting forces, provides a stable kinetic energy that is then, only through its sublimating tension, sustained through exercise.[35] Lenz is discussing the energy of virtue, which itself exists in permanent strain because "it is the nature of every force, that they are only preserved and augmented through exercise, and through neglect, they lull and reduce."[36] This refers to a model of labour avant

32 Arnold Adolph Bertold: Über das Aufrechterscheinen der Gesichtsobjekte trotz des umgekehrt stehenden Bildes derselben auf der Netzhaut des Auges, Göttingen 1834, p. 71.

33 Bertold 1834, p. 74. The role of gravity for the concepts of gravity and the self-reference in the "feeling of strength" (ibid., p. 78) is here – and against the background of the differentiation between life and death (ibid., p. 75–77) – summarised in a detailed manner and finally also related to the upright gait: "Thus through a consumption of muscle strength we become aware of our own weight and the up and down expressed by it. We must mobilise a certain quality of muscle power, in order to keep our body in an upright position." Ibid., p. 79.

34 Jakob Michael Reinhold Lenz: Philosophische Vorlesungen für empfindsame Seelen, facsimile of the edition in Frankfurt/M. and Leipzig 1780, Christoph Weiß (ed.), St. Ingbert 1994.

35 See Heinrich Bosse and Johannes F. Lehmann: Sublimierung bei J.M.R. Lenz, in: Christian Begemann and David E. Wellbery (eds.): Kunst, Zeugung, Geburt. Theorien und Metaphern ästhetischer Produktion in der Neuzeit, Freiburg/Br. 2002, p. 177–201.

36 Lenz to Johann Daniel Salzmann in October 1772, in: Sigrid Damm (ed.): Werke und Briefe in drei Bänden, vol. 3, Frankfurt/M. and Leipzig 1992, p. 289.

la lettre, a model of the power to overcome obstacles: "and as to why God has made what is good for our nature more difficult, the reason is clear, so that we do not go idle; our soul is not made to be still but to walk, to work and to take action."[37]

The fact that the desire for sin can become a metaphor for the force of gravity, also appears in legal discourses of the 18th century, around the same time as Lenz's writing. The famous criminal law theorist Cesare Beccaria compares the desire for sin explicitly with gravity:

> "The force which incessantly enraptures the human being with lust and desire, is similar to gravity which constantly pulls all bodies towards the centre of the earth, and which cannot be stopped unless by obstacles that are placed in its way. All consequences of human action are an effect of this moral gravitational force."[38]

In place of virtue as a force against gravity, the criminal law theorist puts punishment and the power of imagination: "So the wise legislator sets force against force [...]."[39]

But what links the metaphorical application of gravitation to the energies of action on the one side, and the physical-physiological application of the verticality of the human position and movement on the other? They are, according to my theory, the concepts surrounding self-image and the feeling of strength. In other words, the conceptual reflections upon the direct representation of forces in the subjects themselves, and the formulation of this feeling of strength as a specific quality of happiness. It then makes it plausible to affirm and think of the whole psycho-physiological activity of the human being as an expenditure of force against resistance (and gravity).

Even so, a concept of labour is established in the projection of force expenditure against resistance of *all* kind (not merely gravity). This then reassesses labour, not as suffering, but as the overcoming of obstacles and a feeling of strength; as an embodiment of *life.* In the work of Kant, we read:

37 Lenz [1772] 1992, p. 288. To think of work as virtue and virtue as work, in the permanent exertion of force against gravity, was later elaborated upon in a similar way by Simone Weil, in her aphorism on "gravity and grace." Simone Weil: Schwerkraft und Gnade, transl. by Friedhelm Kemp, Munich 1981, in particular p. 7–13.

38 [Karl Ferdinand Hommel]: Des Herren Marquis von Beccaria unsterbliches Werk von Verbrechen und Strafen, Breslau 1778, p. 29. See also p. 162, where sexual desire is seen as "magnetic Newtonic" force.

39 Cesare Beccaria: Über Verbrechen und Strafen, Wilhelm Alff (ed.), Frankfurt/M. and Leipzig 1998, p. 112.

> "Man feels his life through action, and not through indulgence. The more we are busy, the more we feel that we are alive and the more we are aware of our lives [...]. The more we feel our powers, the more we feel our lives."[40]

Every feeling of strength presupposes the obstacle and its overcoming; one can feel life force only against resistance.[41] And in this model, labour occupies the system location, in which life, the feeling of strength and the overcoming of obstacles all come together. For Johannes von Müller, this means: "The most honourable of life's enjoyments is a feeling of strength, which cannot be achieved without practise. Life without labour is like despotism which putrefies in idleness."[42] Work not only stops the onset of decay and thus the preservation of life; an idea well summarised in the German semantic duplication of "faulen" (to decompose) and "faul sein" (to be lazy), but also provides a quality of happiness: "Labour offers a feeling of strength with which comes our greatest pleasure."[43]

Further evidence of this type can be easily provided. I will limit myself to two examples, both of which show that the model is not only abstract philosophy of the 1800s, but at the same time should also be a practical life philosophy for all. The devotional writer Christian Friedrich Sintenis writes in his book *Das Buch fürs Herz aufs ganze Jahr* (1806):

40 Paul Menzer (ed.): A lecture of Kant's about ethics, Berlin 1924, p. 201.

41 These notions of a feeling of strength and resistance were formulated in the sense of sensory- and movements- physiology in the 19th century: Karl Friedrich Burdach: Vom Baue und Leben des Gehirns, Leipzig 1819, p. 91: "The consciousness of our bodily condition is primarily made up of the muscle system, and appears in the form of a feeling of strength." From the feeling of strength awarded by resistance, as it is referred to over and over again, overall ideas of force were also gained: "our muscle-sensitivity is the origin of the concept of force." Wilhelm Wundt: Beiträge zur Theorie der Sinneswahrnehmung, Leipzig and Heidelberg 1862, p. 429. Theodor Lipps develops this on the basis of the force exertion of lifting a stone against gravity: "Alongside the 'aspiration' of the stone, the 'force' of the stone is simultaneously given. In this case, it carries the name gravity or weight. [...] The force of stone is my feeling of strength, drawn out of the stone itself." Theodor Lipps: Grundlegung der Ästhetik, Hamburg and Leipzig 1903, p. 177.

42 Johannes von Müller: Darstellung des Fürstenbundes, Leipzig 1788, p. 17f.

43 Johannes von Müller: Allgemeine Weltgeschichte, nach dem Plan von William Guthrie, John Gray, vol. 78, Brünn 1789, p. 251. See also Johann Gottlieb Fichte: Grundlage der gesammten Wissenschaftslehre als Handschrift für seine Zuhörer, Leipzig 1794, p. 294: "A feeling of strength is the principle of all life; it is the passing from death to life." See the summary of this feeling of strength and a sense of self as understood by Fichte in Petra Lohmann: Der Begriff des Gefühls in der Philosophie Johann Gottlieb Fichtes, Amsterdam and New York 2004, p. 72–79.

> "The mere feeling of strength is already a highly pleasurable feeling, and when does one have this feeling more intimately, than when one is active? [...] Every obstacle overcome through good work produces a special joy, elevates this feeling of strength even more and strengthens the courage."[44]

Johann Michael Hamann, in ever more poetic form, describes the process in his poem *Eingezogenheit*:[45]

> "Bei der Arbeit Hochgenusse,
> Sparsam nur gewürzt durch Muße,
> Fließt der Tag mit sanftem Flusse.
>
> Also muß der Mann gedeihen;
> Stille muß das Herz ihm weihen,
> Arbeit Kraftgefühl ihm leihen."[46]

The principle of life becomes that fact that force is measured against resistance and, as labour, against the forces of gravity. This is the premise for forming a concept of labour-power.

"Labour-Power"

Already in the early 1800s, work, wages, and force were understandably designated central themes. Christian Wolff thought somewhat about wages and work and then, with correlation between the two, began talking about power. Workers are available in different ways. What is missing however, is the abstraction and the term "labour-power."[47] This also applies to the early capitalist theory from Turgot in his book *Reflexions sur la Formation et la Distribution des Richesses* (1770), as well as Adam Smith's paper, *Wealth of Nation* (1776).[48]

44 Christian Friedrich Sintenis: Das Buch fürs Herz aufs ganze Jahr, Leipzig 1806, p. 110.

45 "Eingezogenheit," English translation by Rosie Shackleton:
Work provides one with great pleasure, / Seasoned sparingly with leisure, / The day flows softly by. / And so, man must prosper, / His heart grant him peace, / And work provide a feeling of strength.

46 Johann Michael Hamann: Eingezogenheit, in: Blätter des Gefühls und der Erinnerung, Königsberg 1799, p. 38.

47 Christian Wolff: Vernünfftige Gedancken von dem gesellschafftlichen Leben der Menschen und insonderheit dem gemeinen Wesen, Frankfurt/M. and Leipzig 1736, p. 213f.

48 Cf. To both theorists, as well as the discourse of the economy around 1800 in full, see the study from Joseph Vogl: Kalkül und Leidenschaft. Poetik des ökonomischen Menschen, Zürich and Berlin 2008. Vogl follows the position of the national-economic theories around

Nevertheless, with his theory, Smith lays the foundation for the abstraction of "labour-power," which, in the processes of the economy and reproduction, turns the executed labour into an operand. With reference to "productive powers of labour"[49] and their increase, something which is due to progress in manufacturing and organisation, the abstract and mathematical calculation of labour-power is already in practise. Still Smith talks of "labourers," of the "quantity of labour," but not of "labour-power." He also knows that the abstraction of power finds its limits there, outside of labour itself, where man is also occupied by other life concerns. It may seem logical that in view of sheer labour-power, that "labour-power" always goes there where the best wages are awarded. In reality, however, man cannot move so easily: "A man is of all sorts of luggage the most difficult to transport."[50] A similar ambivalence in the will to abstraction appears in Smith's reflections on the possibilities of increasing the "bodily strengths of the labourer," also presents a simultaneous danger "to over-work themselves, and to hurt their health by excessive labour."[51]

The first existing evidence of "labour-power" that can be found with the Google-Ngram in German, originates from a volume of work by Friedrich Schlichtegroll in the year 1792 containing obituaries of the dead. In a text concerning the Hamburg councillor Peter Diedrich Volkmann, who died in the same year, is written the following:

> "His constitution, which was more feeble than stable, nevertheless granted him an uninterrupted labour-power through abstinence and love of order, not withstanding his continuing health and more so than his outward appearance would have suggested. But with this fraught labour-power, combined with some rather, deeply bottled up grief [...] this noble man succumbed much earlier, that his worried friends had expected."[52]

Here, labour-power, from afar reminiscent of Lenz, is considered as an exertion of force, as something that is wrested from a weak constitution by the means of abstinence, and, at the end, leads to death in a form of an excess voltage.

and after 1800 up the point, "at which a unity of labour processes and life processes" (ibid., p. 344) is established. He touches on the concept of force but does not specifically address the concept of "labour force."

49 Adam Smith: An Inquiry into the Nature and Causes of the Wealth of Nations. In Two Volumes, vol. 1, London 1776, p. 79ff.

50 Smith 1776, p. 91f.

51 Smith 1776, p. 101.

52 Friedrich Schlichtegroll: Nekrolog auf das Jahr 1792. Enthaltend Nachrichten von dem Leben merkwürdiger in diesem Jahre verstorbener Personen, vol. 1, Gotha 1794, p. 53–97, here p. 94.

Labour-power appears as tension force in the field of a *System of forces*, which incorporates bodily and emotional factors.

A primary conclusion from this could be that the term "labour" at the end of the 18th century, wasn't only needed as an identification of activities, but rather the already existing force exertion that laid behind such activities, as well as their repercussions for the system, where power is transferred into action. One of the many examples of this can be found in Franz von Baader's *Elementar-Physiologie:*

> "Here too, we find that in nature's economy, nature awards each and every creature with a more distant and newer reward which he receives directly in hand; a payment of power and a healthy self-image for the labour which he has performed through own labour and effort in the removal of obstacles."[53]

Here, labour is also not a concrete activity, but rather is abstracted to an exertion of force and hereby in the removal of obstacles. It itself then generates force and a self-reference of said force in the form of self-esteem and ego. Labour-power, in this coupling of labour and power, would thus be plausible. It almost appears tautologically; work is the exertion of force against resistance and, equally, out of this grows a vitalisation of new force in and through that feeling of strength; an almost perpetuum mobile. A model that, admittedly as Lenz's example shows, does not function either psychologically or, as Helmholtz shows, physically.

In addition, through the coupling with power, labour becomes a positively associated term; when in the term of "labour-power," labour is not considered effort, suffering, torture or hardship, but rather as a product of strength and as a source of happiness in this feeling of strength.[54] Power is related to the positive quality of the initiator. In labour-power, the performed labour has its beginning and origin. At the same time, the term itself implies a scale, which

53 Franz von Baader: Beyträge zur Elementarphysiologie, Hamburg 1797, p. 59f.

54 That a concept of labour force does not appear in Smith's work, even though he makes labour the core of his entire economic theory, is not least to do with the fact, that here the old, negative value of labour as effort, suffering and hardship was still dominant. Labour is therefore of central value in the economy as every person tries as much as possibly, to evade the struggles of labour and to relinquish them to others: "Labour, therefore is the real measure of the exchangeable value of all commodities." Then: "What every thing is really worth to the man who has acquired it, is the toil and the trouble which it can save to himself, and which it can impose upon other people." Smith 1776, p. 35f.

between the poles of more or less, or strength and weakness, adjusts the focus of the underlying labour-power to preservation, increase and exhaustion.[55]

The term "labour-power" is further utilised in an agricultural context, then in relation to the state economy, and then, shortly after, in relation to the local economy. It is always used in view of the relationship between applied labour-power and realised profit, and in the relation to the *entirety of the power budget* of the state. Earlier proof of this stems from a text concerning clover cultivation in 1797, in which the transition from clover cultivation leads to a reflexion on field cultivation and labour-power. It is "an accurate calculation between the increase of labour, and the needed power of labour," because the corresponding cultivation methods need to correlate to the available quantity of labour-power.[56]

Moreover, in the context of the state economy, it is discussed whether labour-power can be counted as wealth, or rather, as capital itself, or even as income and whether it should be taxed.[57] The foundation for this question was that labour-power is in fact no perpetuum mobile but rather must be generated purely physiologically and is consumed. Against the idea of taxation, it was argued that labour-power consumes itself, in contrast to real estate. In opposition to this, it could be asserted, that the deterioration of labour-power is no argument; one can also consume one's own capital and not bequeath it further.[58] Moreover, the output of humans who possess a labour-power, are themselves linked with the investment of labour and capital:

> "Every individual who has reached maturity, even when not learned in any specific craft or trade, can, in a very real sense, be understood as a machine. A machine which has required twenty years of diligent care and the investment of a considerable amount of capital in its construction. And when a further sum is added, on top of education or ability to carry out the practise

55 See here the works of Anson Rabinbach: Motor Mensch. Kraft, Ermüdung und die Ursprünge der Moderne, transl. by Erik Michael Vogt, Vienna 2001; see also Philipp Sarasin and Jakob Tanner (eds.): Physiologie und industrielle Gesellschaft. Studien zur Verwissenschaftlichung des Körpers im 19. und 20. Jahrhundert, Frankfurt/M. 1998.

56 Friedrich Johann Klapmeyer: Vom Kleebau und von der Verbindung desselben mit dem Getreidebau mit Rücksicht auf die Landwirthschaft in Kurland und Liefland, Riga and Leipzig 1797, p. 42. Klapmeyer wishes to view the "relationship between field cultivation and labour force to be correctly observed" (ibid., p. 32) to consider it as the compulsory labour "on which the labour force of the economy is based." Ibid., p. 153.

57 Karl Murhard: Untersuchung der Frage, ob die Arbeitskraft des Menschen zu den Bestandtheilen des Vermögens zu zählen sey oder nicht? Ein Beytrag zur Theorie der Volkswirthschaft, in: Karl Heinrich Ludwig Pölitz (ed.): Jahrbücher für Geschichte und Politik, vol. 1, Leipzig 1837, p. 137–158.

58 Murhard 1837, p. 151.

> of a trade or occupation, something which requires unusual skill, so will his worth increase proportionately as he qualifies to demand a larger reward for his accomplishments. Exactly as a machine increases in worth, when through the expenses of further capital or further labour, receives new power through its construction."[59]

Karl Marx later identifies the worth of labour-power in *Capital*, a worth which he defines in the "aggregate of those mental and physical capabilities existing in a human being."[60] On one side, he then estimates, like Adam Smith before him,[61] all the costs that arise in order to produce and then maintain the labour-power of the human; Food, clothing, education and upbringing, and, given that the owners of labour are mortal, also all the costs which determine reproduction and child rearing.[62]

On the other hand, however, with such an equivalent to labour and costs, there emerges no additional value for the worker. The "peculiar commodity" of labour-*power* are the very things that produce worth because the practical value of power that is sold, is larger than the value which comes from its mere conservation.[63] It is this concept of "power," represented in a feeling of strength, that makes plausible that excess, that difference in surplus value. Friedrich Engels would later highlight that the adoption of the term "labour-power," as opposed to the term "labour" (as it was still understood in Smith's writings) was the deciding accomplishment of Marxist economic theory:

> "The difficulty over which the best economists came to grief, so long as they started out from the value of 'labour', vanishes as soon as we start out from the value of 'labour *power*' instead. In our present-day capitalist society, labour power is a commodity, a commodity like any other, and yet quite a peculiar commodity. It has, namely, the peculiar property of being a value-creating power, a source of value and, indeed, with suitable treatment, a source of more value than it itself possesses."[64]

59 Murhard 1837, p. 155f.

60 Karl Marx: Capital. A Critique of Political Economy [1867], Eric Hobsbawm et al. (eds.): MECW, vol. 35, London et al. 1996, p. 177.

61 Adam Smith 1776, p. 83.

62 Karl Marx [1867] 1996, p. 182. "The labour-power withdrawn from the market by wear and tear and death, must be continually replaced by, at the very least, an equal amount of fresh labour-power."

63 Karl Marx [1867] 1969, p. 105: "it is the power reserve of the human body, and not the labour itself, which makes up the 'productiveness' of workers."

64 Friedrich Engels: Introduction to Karl Marx's *Wage Labour and Capital* [1891 edition], in: Eric Hobsbawm et al. (eds.): MECW, vol. 27, London et al. 1990, p. 194-201, here p. 200. Also, in Arendt [1958] 2002, p. 105. It is only worth mentioning in passing that the separation between

The fact that *labour-power* as a power that creates value, moves into focus, makes plausible the totalisation of what can be observed, measured, analysed, and increased as labour-power either from humans or animals. Through this analysis of the bodily and mental labour-power, the model of power as being the overcoming of resistance/gravity is found everywhere. This is seen in the aforementioned Szonthag text about the size of labour-power. The text not only concerns the tension force of supplied nourishment, and the question of how much of this combustion product is then lost in warmth,[65] but also the weight of animal carcasses, the leg length in relation to the shift in gravity in the gait, in order to respectively determine how each animal can be used to the greatest efficiency.[66]

The perspective of increased performance, in view of the state economy on a whole, ultimately results in the term "labour-power," and what can be negotiated under it, acquiring a certain vastness. Nothing in the human body is beyond labour-power—whole fields of knowledge; anthropology, zoology, physiology, neurology, biology, physics and also psychology can interact, when occupied by the question concerning the human labour-power. The basic model of gravitation and its relationship to power and resistance is traced down to the molecular level.[67] Nothing that occurs in the body, not, for that matter, anything that occurs in the social environment, is neutral or irrelevant in relation to the maintaining or rather the increase of labour-power.[68]

These manyfold perspectives are summarised in the metaphor of the human as being a mechanical body politic by zoologist, anthropologist, and physiologist Gustav Jäger in his more than 500-page book *Die Menschliche Arbeitskraft*. The human is not *a* machine, "but rather a political system made

person and labour power, i.e. that "the worker does not act as a person but only as a force", raises a number of legal questions concerning questions of the attribution of guilt, insofar as the "enterprise is an order of forces" which "grasps everyone who acts in it only as a force". Cf. Kurt Ballerstedt: Arbeitskraft und Handlungsbegriff, in: Juristenzeitung 8 (1953), p. 389–391, quote from p. 390.

65 Szontagh 1859, p. 10.

66 Szontagh 1859, p. 15–20. Szonthag calculates the labour-power of animals over the distance and the weight of the load needing to be carried in "mile-pounds."

67 Cf. for a further text concerning labour-power in relation to gravity see Christoph Ruth's: Sonnenstrahl und Arbeitskraft der Menschheit. Ein Bild aus Naturwissenschaft und Industrie der Neuzeit, Dortmund 1879, especially the section "Arbeit durch Hebung oder Überwindung der Schwerkraft," p. 8f.

68 This also applies to mental labour-power, as example see Leopold Löwenfeld: Über die geistige Arbeitskraft und ihre Hygiene, Munich 1905, especially the section "Die physiologischen Schwankungen der Arbeitskraft," p. 15–39. See section on "Arbeitsphysiologie."

up of machines; a mechanical state."[69] Here, machines are referring to *all* of the processes in the body, from diet down to the molecular, chemical metabolic processes. However, the gravitational model of force and resistance is at work everywhere. Active force is generated through forces of attraction and through obstacles:

> "The processes of force transformation are first considered as the relationship between tension force and free movement (active force). The cause of the relative appearance is the attraction ratio, which exists between the compounds and that we generally identify as 'Central Force'. These attractions find themselves either in saturated or unsaturated state; The latter, when the attraction ratio of the existing matter has not united because an obstacle stands in the way of this union. An unsaturated state of an attraction is called tension force, as well as available labour. It changes to free movement, active force, or labour, as soon as the obstacle, which stands in the way of this union, is eliminated. The removal of the obstacle can be called the release of tension force."[70]

In Helmholtz's work the whole of nutritional physiology is summarised and determined; the human labour-power originates from the "source of live force"[71] and, like all force, comes from the sun: "the human labour-power originates from the sun."[72]

The perspectivisation of Labour-*power*, that questions the source of power and its escalation (or rather it's exhaustion), enforces a totalisation. Even the most useless child's game is ultimately just training and practise for labour-power. Whoever so wishes to have people with powerful lungs, and therefore who convert more oxygen and work more efficiently, must let the nursing baby cry once a day.[73] So the upward gait of the human being is innate and contributes much to labour-power. However, like growth and posture, it must be culturally supported or, at the very least, not hindered.[74] That the human body is essentially always *labouring*, even through sheer verticality, or mere carrying of a weight, is then the basis (as well as the cause of its failure) of 19th century,

69 Gustav Jäger: Die menschliche Arbeitskraft (=Die Naturkräfte. Eine volkswissenschaftliche Bibliothek), vol. 25 and 26, Munich 1878, p. 3.

70 Jäger 1878, p. 28f.

71 See Jäger 1878, p. 49–57 in chapter "Quelle der Lebenskraft."

72 Jäger 1878, p. 57.

73 Jäger 1878, p. 316. A particular theme would be the issues surrounding gender differences, that, in relation to labour-power, leads to cultural implementation of what each genders assigned work should be. Cf. ibid., p. 318. Cf. here Maria Osietzki: Körpermaschinen und Dampfmaschinen, in: Sarasin and Tanner 1998, p. 313–346.

74 See in full the section in Jäger 1878, p. 315–323 up to "Wuchs und Haltung."

ergonomic study surrounding the exact measuring of labour-power and its exhaustion.[75]

In contrast, beyond labour and beyond force expenditure to the overcoming of gravity, a levitation certainly appears – quasi as the other side of the modern focus on gravitation – as a utopian expression of anti-gravitational grace and dance.[76] Even in relation to the handling of stones, the labour process can be imagined beyond its relation to gravity. In a small text from Kafka about the building of a temple it is thus described:

> "Everything in the building complies with him. Foreign workers brought stones of marble, hewed, and belonging to each other. Following measured movements, his fingers lifted the stones and displaced them. No structure came into being as easily as this temple, or more so, this temple came into being out of the true art of the temple."[77]

No labour is necessary here, "foreign workers" had already executed the stonemasonry and the builder then lifts the stone to its place by means of a mere finger movement, just so, as if operating by a quasi-magical electrical hoisting machine, like those in the high-rises established at the beginning of the 20th century. Kafka was able to see such images of New York in the cinemas: "houses with 50 floors under construction,"[78] with electrical cranes, that lift and join stones by mere finger movements.

75 Cf. here Francois Vatin: Arbeit und Ermüdung. Entstehung und Scheitern der Psychophysiologie der Arbeit, in: Sarasin and Tanner 1998, p. 347–368. Vatin shows that this failure was connected with a concept of work, that targeted strain and usefulness and couldn't even be adequately included, that the "organism is always in action." Ibid., p. 366. Nevertheless, the totalisation of labour-power, in all activity and areas of the organism underlie all these efforts. Moreover, even with effort and usefulness the issue is also not grasped; labour-power as opposed to labour, has made it plausible that that feeling of strength comes from the activity itself.

76 Here, one should of course think of Schiller's "Über Anmut und Würde" (1793) as well as of Kleist's "Über das Marionettentheater" (1811). Cf. here Margarete Fuchs: Von Risiko, Schwindel und Balance. Circensische Äquilibristik, in: Eckart Goebel and Cornelia Zumbusch (eds.): Balance. Figuren des Äquilibriums in den Kulturwissenschaften, Berlin and Boston 2020, p. 193–204.

77 Franz Kafka: Nachgelassene Schriften und Fragmente II, Jost Schillemeit (ed.), Darmstadt 1992, p. 107f. Cf. For more details on this text see my essay: Leben Arbeit Tod – zur literarischen Bedeutung von Dingen und Steinen bei Homer, Schiller, Flaubert und Kafka, in: Alexander King and Martina Wernli (eds.): Res und Verba. Zu den Narrativen der Dinge, Freiburg/Br. 2018, p. 225–240.

78 The poster of a cinematograph with this announcement from October 1908 was printed by Hanns Zischler: Kafka goes to the cinema, Reinbek 1996, p. 83.

The superelevation of the overcoming of gravity through mythical or technical "magic" is also freely accompanied by the possibility of interpreting the heaviness of stone and the labour-power generated by it, as equally mythical. Not least of all, the feeling of strength acquired through heavy stone, something which grounds and accompanies this reassessment of labour into physiological, economical, and politically instrumentalised labour-power, then leads to the celebration of heavy stone seen during National Socialism. For the art historian Alfred Stange, the German being and its heroic power lies in the esteem and bond with the mastering of heavy stone:

> "Such a race of heroes and heroines could only arise with he who experiences stone as a natural and fundamental raw material. One must be connected with the massiveness, blockiness and heaviness of stone, must respect the nature of the stone within himself, in order to make this character of stone, in a truthful, wonderful and genial way, into the expression of such a powerfully down-to-earth, such a mightily heroic humanity."[79]

With such an uplifting, pre-modern, heroic power in the heaviness of stone, corresponds an ideological instrumentalisation of labour under National Socialism (through simultaneous maximal exploitation of the labour-power of others, to the "extermination through work" in the stone breaking of the concentration camps).[80] In the face of modern possibilities to supplement the exertion of bodily force, and to narrow down multiple labour processes through machines and robots (or to let others complete the remaining body-work), the economical concept of labour-power as having a relationship with the overcoming of gravity has long since dissipated and today is more or less used as a synonym for a worker. For the history of the concept, however, its relation to the force of gravity is inescapable.

Translated from the German by Rosie Shackleton.[81]

79 Alfred Stange: Die Bedeutung des Werkstoffes in der deutschen Kunst, Leipzig 1940, p. 69f.

80 Cf. here summarised: Marc Buggeln and Michael Wildt (eds.): Arbeit im Nationalsozialismus, Munich 2014.

81 Translator's note: some of the scientific concepts discussed in the original German text have no direct English translation, I have therefore offered an in text explanation of the concepts where applicable.

BAND III

Imaginarien der Kraft

HERAUSGEGEBEN VON

FRANK FEHRENBACH
CORNELIA ZUMBUSCH

Energetic Bodies
Sciences and Aesthetics of Strength and Strain

Edited by
Thomas Moser and Wilma Scheschonk

DE GRUYTER

Published with support from the Gerda Henkel Foundation, Düsseldorf and the DFG Centre for Advanced Studies Imaginaria of Force.

GERDA HENKEL STIFTUNG

Imaginarien der Kraft

ISBN 978-3-11-076706-3
e-ISBN (PDF) 978-3-11-076716-2
ISSN 2698-7899

Library of Congress Control Number: 2022935568

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at http://dnb.dnb.de.

Cover illustration: Etienne Jules Marey, *Homme nu descendant de bicyclette*, 1891, black-and-white print, Paris, Iconothèque de la Cinémathèque française.
Layout and typesetting: P. Florath, Stralsund
Printing and binding: Druckhaus Sportflieger, Berlin

www.degruyter.com