CLAUDE BERNARD INTRODUCTION TO THE STUDY OF EXPERIMENTAL MEDICINE pdf

1: Claude Bernard, An Introduction to the Study of Experimental Medicine, tr

In An introduction to the study of experimental medicine, Claude Bernard remarkably described 'the experimental method'. He particularly defined 'the absolute principle' of the experimental method and 'the experimental truth'.

On a broader stage, Bernard played a role in establishing the principles of experimentation in the life sciences, advancing beyond the vitalism and indeterminism of earlier physiologists to become one of the founders of experimental medicine. His most seminal contribution was his concept of the internal environment of the organism, which led to the present understanding of homeostasis â€”i. When Claude was very young, his father failed in a wine-marketing venture and tried to make ends meet by teaching school. Despite his efforts, the family never prospered, and when he died, the survivors were left in debt. The boy studied Latin with the local priest and then was enrolled in a Jesuit-conducted school at Villefranche, where no natural science was taught. At 18 Bernard ended his secondary schooling at Thoissey without a diploma and was apprenticed to an apothecary in a Lyon suburb. His employer was not pleased, however, and the apprenticeship came to a halt, the youth returning home in July By November he was in Paris with the completed manuscript of Arthur de Bretagne and a letter of introduction. The literary critic Saint-Marc Girardin read his play and advised him to try medicine instead of playwriting. Bernard enrolled that same winter in the Faculty of Medicine in Paris and, in due course, was admitted as an extern in the hospitals. Outwardly reserved and even shy at that time, he had an inner strength that was to overcome poverty and discouragements. Of 29 students passing the examination for the internship, Bernard ranked 26th. His first publication dealt with the chorda tympani a branch of the facial nerve , while his medical dissertation was devoted to the function of the gastric juice in nutrition These maiden publications were prophetic, for much of his later research concerned neurology and metabolism. Failing in the examination that would have qualified him to teach in the medical school, he collaborated with others in research on digestion and on the exotic poison curare, thus treading two paths that would lead him to fame. He was rather old at the age of 31 to be content with a research assistantship, however, and resigned the position late in Left in financial straits, he turned his thoughts again toward medical practice. The marriage brought him a dowry of 60, francs but was destined to be painfully unhappy. Their separation was to follow his election to the French Academy late in life. Research on the pancreas and the liver. This period was marked by a veritable explosion of discoveries, beginning in , when Bernard solved the mystery of the carnivorous rabbits. Puzzled one day by the chance observation that some rabbits were passing clearâ€”not cloudyâ€”urine, just like meat-eating animals, he inferred that they had not been fed and were subsisting on their own tissues. He confirmed his hypothesis by feeding meat to the famished animals. An autopsy of the rabbits yielded an important discovery concerning the role of the pancreas in digestion: Bernard then showed that the principal processes of digestion take place in the small intestine , not in the stomach as was previously believed. His work on the pancreas led to research on the liver , culminating in his second great discovery, the glycogenic function of the liver. In Bernard discovered glycogen , a white starchy substance found in the liver. He found that this complex substance was built up by the body from sugar and served as a storage reserve of carbohydrates that could be broken down to sugars as needed, thereby keeping the sugar content of the blood at a constant level. Simultaneously, he was nearing his third great achievementâ€”explanation of the regulation of the blood supply by the vasomotor nerves. He discovered in this regard that the vasomotor nerves control the dilation and constriction of blood vessels in response to temperature changes in the environment. For example, in cold weather the blood vessels of the skin constrict in order to conserve heat, while in hot weather they expand to dissipate excess heat. This control mechanism, like the glycogenic functions of the liver, illustrates how the body maintains a stable internal environment in the midst of changing external conditionsâ€”a fundamental phenomenon known as homeostasis. Bernard also conducted important studies on the effects of such poisons as carbon monoxide and curare on the body. He showed that carbon monoxide could substitute for oxygen and combine with hemoglobin, thereby causing oxygen starvation. His experiments with curare showed how this dread poison causes paralysis and death by attacking the motor nerves, while having no effect on the sensory nerves. He demonstrated that, because of this selectivity, curare could be used as an experimental tool in differentiating neuromuscular from primary muscular mechanisms. Recognition and later work. Within less than a decade, from obscurity in the shadow of Magendie, he had risen to a commanding position in science. In a chair of general physiology was created for him in the Sorbonne, and he was elected to the Academy of Sciences. No laboratory had been provided for Bernard at the Sorbonne, but the French emperor Napoleon III , after an interview with him in , remedied the deficiency, at the same time building a laboratory at the Museum of Natural History of the Jardin des Plantes. In Bernard left the Sorbonne to accept a newly established professorship in general physiology at this museum. The productive researcher was turning into a philosopher of science. Failing health after led him to spend more time at Saint-Julien, less time in the laboratory. Bernard suffered apparently from chronic enteritis, with symptoms affecting the pancreas and the liver. This work was planned as a preface, if a very long one, to a work of greater magnitude, never completed. The book brought new honours to Bernard, notably election to the French Academy in Bert succeeded Bernard in the Sorbonne when the latter transferred to the Museum of Natural History in The phenomena common to animals and plants formed the subject of lectures published posthumously. He also began research on fermentation. Soon he was confined to his bed. At his death Bernard was accorded a funeral arranged and financed by the government, the first ever granted to a scientist in France. Bernard, ClaudeClaude Bernard, illustration of a statue.

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2: An Introduction to the Study of Experimental Medicine by Claude Bernard

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For permissions, please e-mail: For commercial re-use, please contact journals. Introduction In a recent case report article in this journal, the authors described a case of turbid white urine due to a lymphatic fistula [1]. In their discussion, the authors mentioned that rabbits, a species feeding on vegetable, excrete alkaline turbid urine. The paper also ascribed this observation to Claude Bernard â€" This sparked our interest in these experiments and the man who conducted them. The original experiment One day rabbits from the market were brought into my laboratory. They were put on the table where they urinated, and I happened to observe that their urine was clear and acid. This fact struck me, because rabbits, which are herbivore, generally have turbid and alkaline urine. I assumed they had probably not eaten for a long time. At autopsy of these rabbits, he also deduced, from the position of the pancreatic duct, that pancreatic juice must have a role in the digestion of fat. What is the physiology behind his observations on urine pH? Meat contains plenty of cysteine and methionine, which in their metabolism eventually yield sulphuric acid [4]. This eventually appears in urine and decreases the urine pH [5]. Bernard could not possibly be aware of this, as protein biochemistry was still in its infancy: Cysteine was only discovered in [6] although its dimer, cystin, had been described earlier. Methionine was only discovered in [7]. In humans, another dietetic influence on the urine pH is the intake of phosphoproteins, which yield phosphoric acid when hydrolysed. These are usually found in eggs and egg products and thus unlikely to play a role in the rabbits studied by Claude Bernard. A vegetarian diet will contain little cysteine and methionine and few phosphoproteins, leading to a net alkaline load [4]. We also know today that calcium carbonate and phosphate can precipitate in alkaline urine, leading to a cloudy or turbid appearance. Fasting also affects the urine pH, both in carnivores and herbivores: In this case, free fatty acyl CoA can enter the mitochondria where conversion to 3-hydroxybutyric acid and acetoacetic acid occurs [8]. This, too, was unknown in the early and mid-nineteenth century: Hydroxybutyrate was only discovered in by year-old Oskar Minkowski [9]. Modern concepts of acidâ€"base physiology were also unknown at the time: It took until when Lawrence Henderson, a gourmet and oenophile, came up with his famous equation and the modern understanding of acidâ€"base disorders [10]. Claude Bernardâ€"early life and studies Bernard was born in in Saint-Julien in the Rhone department in eastern France. The son of poor vineyard workers, he attended a Jesuit village school but dropped out without diploma. At 19 years of age, he was then apprenticed to a local apothecary in Lyon. In his spare time, however, he dreamed of becoming a writer. He thus entered the Faculty of Medicine in Paris where he is said to have been a conscientious but not brilliant student. In fact, in his internship exam, he came 26 of the 29 students who passed. However, 4 years later, he became an assistant to Prof. Francois Magendie, head of the department of physiology in Paris. Another important event was marriage to Fanny Martin, the daughter of a wealthy physician. This marriage, possibly arranged, enabled Bernard to fund his own research, which was not always supported by Magendie. She was also very active in the Societe Protectrice des Animaux, the French society for the protection of animals and one of the first such societies in Europe. It is believed that Mme. Not surprisingly, the Bernards separated in Thereafter, Fanny and her two daughters established a rescue home for dogs. While many pictures of her husband survive, we failed to retrieve a single image of this remarkable woman. The experiments on the carnivorous rabbits are believed to have been conducted around in this basement laboratory. Some 50 years previously, the area had been a hotbed of activity during the French Revolution:

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3: Claude Bernard's "Introduction to the Study of Experimental Medicine" | JAMA | JAMA Network

Claude Bernard, An Introduction to the Study of Experimental Medicine, trans. H.C. Green (New York: Dover Publications, []); pp. , , In Experimental Reasoning, Experimenters Are Not Separate from Observers.

Dover Publications, [] ; pp. In Experimental Reasoning, Experimenters Are Not Separate from Observers Men of science who mean to embrace the principles of the experimental method as a whole, must fulfill two classes of conditions and must possess two qualities of mind which are indispensable if they are to reach their goal and succeed in the discovery of truth. First, they must have ideas which they submit to the control of facts; but at the same time they must make sure that the facts which serve as starting point or as control for the idea are correct and well established; they must be at once observers and experimenters. Observers, we said, purely and simply note the phenomena before their eyes. They must be anxious only to forearm themselves against errors of observation which might make them incompletely see or poorly define a phenomenon. To this end they use every instrument which may help make their observations more complete. Observers, then, must be photographers of phenomena; their observations must accurately represent nature. But when a fact is once noted and a phenomenon well observed, reasoning intervenes, and the experimenter steps forward to interpret the phenomenon. An experimenter, as we have already said, is a man inspired by a more or less probable but anticipated interpretation of observed phenomena, to devise experiments which, in the logical order of his anticipations, shall bring results serving as controls for his hypothesis or preconceived idea. To do this, an experimenter reflects, tries out, gropes, compares, contrives, so as to find the experimental conditions best suited to gain the end which he sets before him. Of necessity we experiment with a preconceived idea. Phenomena then appear which the experimenter has caused, but which must now be noted, so as to learn next how to use them to control the experimental idea which brought them to birth. Now, from the moment when the result of an experiment appears, the experimenter is confronted with a real observation which he has induced and must note the results of the experiment exactly, like those of an ordinary observation, without any preconceived idea. The experimenter must now disappear or rather change himself instantly into an observer; and it is only after he has noted the results of the experiment exactly, like those of an ordinary observation, that his mind will come back, to reason, compare and decide whether his experimental hypothesis is verified or disproved by these very results. To maintain the comparison suggested above, I may say that our experimenter puts questions to nature; but that, as soon as she speaks, he must hold his peace; he must note her answer, hear her out and in every case accept her decision. It has been said that the experimenter must force nature to unveil herself. Yes, the experimenter doubtless forces nature to unveil herself by attacking her with all manner of questions; he must never answer for her nor listen partially to her answers by taking, from the results of an experiment, only those which support or confirm his hypothesis. We shall see later that this is one of the great stumbling blocks of the experimental method. An experimenter, who clings to his preconceived idea and notes the results of his experiment only from this point of view, falls inevitably into error, because he fails to note what he has not foreseen and so makes a partial observation. An experimenter must not hold to his idea, except as a means of inviting an answer from nature. But he must submit his idea to nature and be ready to abandon, to alter or to supplant it, in accordance with what he learns from observing the phenomena which he has induced pp. The A Priori Idea and Doubt in Experimental Reasoning Everyone first works out his own ideas about what he sees and is inclined to interpret natural phenomena by anticipation before knowing them through experience. This tendency is spontaneous; a preconceived idea always has been and always will be the first flight of an investigating mind. But the object of the experimental method is to transform this a priori conception, based on an intuition or a vague feeling about the nature of things, into an a posteriori interpretation founded on the experimental study of phenomena. This is why the experimental method is also called the a posteriori method. Man is by nature metaphysical and proud. He has gone so far as to think that the idealistic creations of his mind, which correspond to his feelings, also represent reality. Hence it follows that the experimental method is by no means primitive or natural to man, and that only after lengthy wanderings in theological and scholastic discussion has he recognized at last the sterility of his efforts in this direction. At this point man becomes aware that he cannot dictate laws to nature, because he does not contain within himself the knowledge and criterion of external things, and he understands that to find truth he must, on the contrary, study natural laws and submit his ideas, if not his reason, to experience, that is, to the criterion of facts. Yet for all that, the method of work of the human mind is not changed at bottom. The metaphysician, the scholastic, and the experimenter all work with an a priori idea. The difference is that the scholastic imposes his idea as an absolute truth which he has found, and from which he then deduces consequences by logic alone. The more modest experimenter, on the other hand, states an idea as a question, as an interpretative, more or less probable anticipation of nature, from which he logically deduces consequences which, moment by moment, he confronts with reality by means of experiment. He advances, thus, from partial to more general truths, but without ever daring to assert that he has grasped the absolute truth. Indeed if we held it at any point whatever, we should have it everywhere; for the absolute leaves nothing outside itself. An experimental idea, then is also an a priori idea, but it is an idea that presents itself in the form of an hypothesis the consequences of which must be submitted to the criterion of experiment, so that its value may be tested. In teaching man, experimental science results in lessening his pride more and more by proving to him every day that primary causes, like the objective reality of things, will be hidden from him forever and that he can know only relations. Here is, indeed, the one goal of all the sciences, as we shall see further on. The human mind has at different periods of its evolution passed successively through feeling, reason, and experiment. First, feeling alone, imposing itself on reason, created the truths of faith or theology. At last, experiment, or the study of natural phenomena, taught man that the truths of the outer world are to be found ready formulated neither in feeling nor in reason. These are indispensable merely as guides; but to attain external truths we must of necessity go down into the objective reality of things where they lie hidden in their phenomenal form. Thus, in the natural progress of things, appeared the experimental method which includes everything and which, as we shall soon see, leans successively on the three divisions of that unchangeable tripod: In the search for truth by means of this method, feeling always takes the lead, it begets the a priori idea or intuition; reason or reasoning develops the idea and deduces its logical consequences. But if feeling must be clarified by the light of reason, reason in turn must be guided by experiment pp. Experimenters Must Doubt, Avoid Fixed Ideas, and Always Keep Their Freedom of Mind The first condition to be fulfilled by men of science, applying themselves to the investigation of natural phenomena, is to maintain absolute freedom of mind, based on philosophic doubt. Yet we must not be in the least skeptical; we must believe in science, i. When we propound a general theory in our sciences, we are sure only that, literally speaking, all such theories are false. They are only partial and provisional truths which are necessary to us, as steps on which we rest, so as to go on with investigation; they embody only the present state of our knowledge, and consequently they must change with the growth of science, and all the more often when sciences are less advanced in their evolution. On the other hand, our ideas come to us, as we said, in view of facts which have been previously observed and which we interpret afterward. Now countless sources of error may slip into our observations, and in spite of all our attention and sagacity, we are never sure of having seen everything, because our means of observation are often too imperfect. The result of all this is, then, that if reasoning guides us in experimental science, it does not necessarily force its deductions upon us. Our mind can always remain free to accept or to dispute these deductions. If an idea presents itself to us, we must not reject it simply because it does not agree with the logical deductions of a reigning theory. We may follow our feelings and our idea and give free rein to our imagination, as long as all our ideas are mere pretexts for devising new experiments that may supply us with convincing or unexpected and fertile factsâ€¦. This is unluckily what has happened and still happens to the men whom I shall call systematizers. These men start, in fact, from an idea which is based more or less on observation, and which they regard as an absolute truth. They then reason logically and without experimenting, and from deduction to deduction they succeed in building a system which is logical, but which has no sort of scientific reality. Superficial persons often let themselves be dazzled by this appearance of logic; and discussions worthy of ancient scholasticism are thus sometimes renewed in our day. The excessive faith in reasoning, which leads physiologists to a false simplification of things, comes, on the one hand, from ignorance of the science of which they speak, and, on the other hand, from lack of a feeling for the complexity of natural phenomenaâ€¦. Men who have excessive faith in their theories or ideas are not only ill prepared for making discoveries; they also make very poor observations. Of necessity, they observe with a preconceived idea, and when they devise an experiment, they can see, in its results, only a confirmation of their theory. In this way they distort observation and often neglect very important facts because they do not further their aimâ€¦. But it happens further quite naturally that men who believe too firmly in their theories, do not believe enough in the theories of others. The difficulty, for science, is still the same. They make experiments only to destroy a theory, instead of to seek the truth. At the same time, they make poor observations, because they choose among the results of their experiments only what suits they object, neglecting whatever is unrelated to it, and carefully setting aside everything which might tend toward the idea they wish to combat. By these two opposite roads, men are thus led to the same result, that is, to falsify science and the facts. Accordingly, we must disregard our own opinion quite as much as the opinion of others, when faced by the decisions of experience. If men discuss and experiment, as we have just said, to prove a preconceived idea in spite of everything, they no longer have freedom of mind, and they no longer search for truth. Theirs is a narrow science, mingled with personal vanity or the diverse passions of man. Pride, however, should have nothing to do with all these vain disputes. When two physiologists or two doctors quarrel, each to maintain his own ideas or theories, in the midst of their contradictory arguments, only one thing is absolutely certain: The truly scientific spirit, then, should make us modest and kindly. We really know very little, and we are all fallible when facing the immense difficulties presented by investigation of natural phenomena. The best thing, then, for us to do is to unite our efforts, instead of dividing them and nullifying them by personal disputes. In a word, the man of science wishing to find truth must keep his mind free and calm, and if it be possible, never have his eye bedewed, as Bacon says, by human passions. In scientific education, it is very important to differentiate, as we shall do later, between determinism which is the absolute principle of science, and theories which are only relative principles to which we should assign but temporary value in the search for truth. In a word, we must not teach theories as dogmas or articles of faith. By exaggerated belief in theories, we should give a false idea of science; we should overload and enslave the mind, by taking away its freedom, smothering its originality and infecting it with the taste for systems. The theories which embody our scientific ideas as a whole are, of course, indispensable as representations of science. They should also serve as a basis for new ideas. But as these theories and ideas are by no means immutable truth, one must always be ready to abandon them, to alter them or to exchange them as soon as they cease to represent the truth. In a word, we must alter theory to adapt it to nature, but no nature to adapt it to theory. To sum up, two things must be considered in experimental science: The object of method is to direct the idea which arises in the interpretation of natural phenomena and in the search for truth. The idea must always remain independent, and we must no more chain it with scientific beliefs than with philosophic or religious beliefs; we must be bold and free in setting forth our ideas, must follow our feeling, and must on no account linger too long in childish fear of contradicting theories. If we are thoroughly steeped in the principles of the experimental method, we have nothing to fear; for, as long as the idea is correct, we go on developing it; when it is wrong, experimentation is there to set it right. We must be able, then, to attack questions even at the risk of going wrong. We do science better service, as has been said, by mistakes than by confusion, which means that we must fearlessly push ideas to their full development, provided that we regulate them and are always careful to judge them by experiment. The idea, in a word, is the motive of all reasoning, in science as elsewhere. But everywhere the idea must be submitted to a criterion. In science the criterion is the experimental method or experiment; this criterion is indispensable, and we must apply it to our own ideas as well as to those of others pp. It is a guide, a light, but not an absolute authority. The revolution which the experimental method has effected in the sciences is this: The experimental method is characterized by being dependent only on itself, because it includes within itself its criterion, --experience. It recognizes no authority other than that of facts and is free from personal authority. When Descartes said that we must trust only to evidence or to what is sufficiently proved, he meant that we must no longer defer to authority, as scholasticism did, but must rely only on facts firmly established by experience. The result of this is that when we have put forward an idea or a theory in science, our object must not be to preserve it by seeking everything that may support it and setting aside everything that may weaken it.

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Introduction to the Study of Experimental Medicine Claude Bernard and pupils In his major discourse on the scientific method, An Introduction to the Study of Experimental Medicine ([14]), Bernard described what makes a scientific theory good and what makes a scientist important, a true discoverer.

The experimental method is the scientific method which proclaims the freedom of the mind and of thought. The determinism of phenomena, i. They know the necessity, absolute relations and conditions behind the facts they observe. Not all facts must be accepted; only definite, accurate and well-observed experimental facts generate experimental truth. The experimental truth is the foundation for experimental reasoning. It is founded on doubt which experimenters must maintain for it "leaves to the mind its freedom and initiative". If the mind no longer has freedom of action, it lacks, wrote Bernard, "the power to break away from that blind faith in theories which is only scientific superstition". Experimenters in search for truth no longer defers to personal authority, they rely solely on experimental facts and, as Bernard emphasized, "in the experimental sciences, great men are never the promoters of absolute and immutable truths". Experimental science develops in laboratory. Do not substitute the authority of facts for the authority of books - warns Bernard echoing Descartes in admitting nothing as truth, unless clearly recognizable as such. A genius in the field of physiology, Claude Bernard discovered the production of sugar in the liver of man and animals. However the accepted theory proclaimed animals could not produce sugar; vegetable matter did so for animal consumption. He enlarged science by adding knowledge, both new facts and an exceptional account of the experimental method he applied to his investigations. His grandeur is revealed as he wrote in his Introduction, "One of the greatest obstacles to the free and universal movement of human knowledge is the tendency that leads different kinds of knowledge to separate into systems. This is not a consequence of things in themselves, because everything in nature is connected with everything else and nothing should be viewed in the isolation of a system; but the feeble yet dominating tendency of our minds leads us to absorb other kinds of knowledge into our personal system. Claude Bernard has been criticized on moral grounds for his experiments involving vivisection. If it is immoral, then, to make an experiment on man when it is dangerous to him, even though the result may be useful to others, it is essentially moral to make experiments on an animal, even though painful and dangerous to him, if they may be useful to man". His spirit may have been of pure science, and his mind free from further consideration for benefiting scientific knowledge. Preface on Doctors, The experiment [on human subjects] should be so designed and based on the results of animal experimentation and a knowledge of the natural history of the disease or other problem under study that the anticipated results will justify the performance of the experiment.

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5: Claude Bernard - Wikipedia

An Introduction to the Study of Experimental Medicine has 44 ratings and 3 reviews. Bruce said: Published in , this work came not from an unknown aut.

Experimental Reasoning Chapter 1. Observation and Experiment i. Various definitions of observation and experiment [p. Gaining experience and relying on observation is different from making experiments and making observations [p. The investigator; scientific research [p. Observers and experimenters; the sciences of observation and experiment [p. Experiment is fundamentally only induced observation [p. In experimental reasoning, experimenters are not separate from observers [p. Experimental truths are objective or external [p. Intuition or feeling begets the experimental idea [p. Experimenters must doubt, avoid fixed ideas, and always keep their freedom of mind [p. The independent character of the experimental method [p. Induction and deduction in experimental reasoning [p. Doubt in experimental reasoning [p. The principle of the experimental criterion [p. Proof and counterproof [p. Experimentation with Living Beings Chapter 1. The spontaneity of living beings is no obstacle to the use of experimentation [p. Manifestation of properties of living bodies is connected with the existence of certain physico-chemical phenomena which regulate their appearance [p. Physiological phenomena in the higher animals take place in perfected internal organic environments endowed with constant phsycio-chemical properties [p. The aim of experimentation is the same in study of phenomena of living bodies as in study of phenomena of inorganic bodies [p. The necessary conditions of natural phenomena are absolutely determined in living bodies as well as in inorganic bodies [p. To have determinism for phenomena, in biological as in physico-chemical sciences, we must reduce the phenomena to experimental conditions as definite and simple as possible [p. In living bodies, just as in inorganic bodies, the existence of phenomena is always doubly conditioned viii. In biological as in physico-chemical science, determinism is possible, because matter in living as in inorganic bodies can possess no spontaneity [p. The limits of our knowledge are the same in the phenomena of living bodies and in the phenomena of inorganic bodies [p. In the sciences of living bodies, as in those of inorganic bodies, experimenters create nothing; they simply obey the laws of nature [p. Experimental Considerations Peculiar to Living Beings i. The phenomena of living beings must be considered as a harmonious whole [p. Experimental practice with living beings [p. Normal anatomy in its relations with vivisection [p. Pathological anatomy and dissection in relation to vivisection [p. The variety of animals subjected to experimentation; the variability of organic conditions which they present to experimenters [p. The choice of animals; the usefulness to medicine of experiments on various species of animals [p. Comparison between animals and comparative experimentation [p. The use of calculations in study of living beings; averages and statistics [p. Examples of Experimental Physiological Investigation i. Where the starting point for experimental research is an observation [p. When the starting point of experimental research is an hypothesis or a theory [p. Examples of Experimental Physiological Criticism i. The principle of experimental determinism does not admit of contradictory facts [p. The principle of determinism ejects causeless and irrational facts from science [p. The principle of determinism requires comparative determination of facts [p. Experimental criticism should bear on facts alone and never on words [p. Investigation and Criticism as Applied to Experimental Medicine i. Pathological and therapeutic investigation [p. Experimental criticism in pathology and therapeutics [p. Philosophic Obstacles Encountered by Experimental Medicine i. The false application of physiology to medicine [p. Scientific ignorance and certain illusions of the scientific spirit hinder the development of experimental medicine [p. Empirical and experimental medicine are by no means incompatible; on the contrary, they must be inseparable [p. Experimental medicine does not correspond to any medical doctrine or any philosophic system [p.

6: Claude Bernard's study of experimental medicine

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His field of research was considered inferior at the time, the laboratory assigned to him was simply a "regular cellar". When he died on 10 February , he was accorded a public funeral â€” an honor which had never before been bestowed by France on a man of science. He dismissed many previous misconceptions, took nothing for granted, and relied on experimentation. Unlike most of his contemporaries, he insisted that all living creatures were bound by the same laws as inanimate matter. A third research resulted in the discovery of the vasomotor system. In , while examining the effects produced in the temperature of various parts of the body by section of the nerve or nerves belonging to them, he noticed that division of the cervical sympathetic nerve gave rise to more active circulation and more forcible pulsation of the arteries in certain parts of the head, and a few months afterwards he observed that electrical excitation of the upper portion of the divided nerve had the contrary effect. In this way he established the existence of vasomotor nerves , both vasodilator and vasoconstrictor. He also explained that: The living body, though it has need of the surrounding environment, is nevertheless relatively independent of it. This independence which the organism has of its external environment, derives from the fact that in the living being, the tissues are in fact withdrawn from direct external influences and are protected by a veritable internal environment which is constituted, in particular, by the fluids circulating in the body. The constancy of the internal environment is the condition for free and independent life: The constancy of the environment presupposes a perfection of the organism such that external variations are at every instant compensated and brought into balance. In consequence, far from being indifferent to the external world, the higher animal is on the contrary in a close and wise relation with it, so that its equilibrium results from a continuous and delicate compensation established as if the most sensitive of balances. The physiologist is no ordinary man. He is a learned man, a man possessed and absorbed by a scientific idea. He is blind to the blood that flows. He sees nothing but his idea, and organisms which conceal from him the secrets he is resolved to discover. Unlike many scientific writers of his time, Bernard wrote about his own experiments and thoughts, and used the first person. What makes a scientist important, he states, is how well he or she has penetrated into the unknown. In areas of science where the facts are known to everyone, all scientists are more or less equalâ€"we cannot know who is great. But in the area of science that is still obscure and unknown the great are recognized: It is through the experimental method that science is carried forwardâ€"not through uncritically accepting the authority of academic or scholastic sources. In the experimental method, observable reality is our only authority. Bernard writes with scientific fervor: When we meet a fact which contradicts a prevailing theory, we must accept the fact and abandon the theory, even when the theory is supported by great names and generally accepted. Experimental science is a constant interchange between theory and fact, induction and deduction. Induction, reasoning from the particular to the general, and deduction, or reasoning from the general to the particular, are never truly separate. A general theory and our theoretical deductions from it must be tested with specific experiments designed to confirm or deny their truth; while these particular experiments may lead us to formulate new theories. The scientist tries to determine the relation of cause and effect. This is true for all sciences: We formulate hypotheses elucidating, as we see it, the relation of cause and effect for particular phenomena. We test the hypotheses. And when an hypothesis is proved, it is a scientific theory. Bernard explains what makes a theory good or bad scientifically: Theories are only hypotheses, verified by more or less numerous facts. Those verified by the most facts are the best, but even then they are never final, never to be absolutely believed. Indeed, proof that a given condition always precedes or accompanies a phenomenon does not warrant concluding with certainty that a given condition is the immediate cause of that phenomenon. It must still be established that when this condition is removed, the phenomenon will no longer appearâ€¦ [20] We must always try to disprove our own theories. If through experiment, you contradict your own conclusionsâ€”you must accept the contradictionâ€”but only on one condition: In the study of disease, "the real and effective cause of a disease must be constant and determined, that is, unique; anything else would be a denial of science in medicine. Sometimes averages do not give the kind of information needed to save lives. A great surgeon performs operations for stone by a single method; later he makes a statistical summary of deaths and recoveries, and he concludes from these statistics that the mortality law for this operation is two out of five. Well, I say that this ratio means literally nothing scientifically and gives us no certainty in performing the next operation; for we do not know whether the next case will be among the recoveries or the deaths. What really should be done, instead of gathering facts empirically, is to study them more accurately, each in its special determinismâ€¦. Therefore, for now the goal of medical science should be to discover all the new facts possible. Qualitative analysis must always precede quantitative analysis. The "philosophic spirit", writes Bernard, is always active in its desire for truth. It stimulates a "kind of thirst for the unknown" which ennobles and enlivens scienceâ€”where, as experimenters, we need "only to stand face to face with nature". Meanwhile, there are those whose "minds are bound and cramped". In this way, they "falsify science and the facts": They make poor observations, because they choose among the results of their experiments only what suits their object, neglecting whatever is unrelated to it and carefully setting aside everything which might tend toward the idea they wish to combat. The "despisers of their fellows" lack the "ardent desire for knowledge" that the true scientific spirit will always haveâ€”and so the progress of science will never be stopped by them. Ardent desire for knowledge, in fact, is the one motive attracting and supporting investigators in their efforts; and just this knowledge, really grasped and yet always flying before them, becomes at once their sole torment and their sole happinessâ€¦. A man of science rises ever, in seeking truth; and if he never finds it in its wholeness, he discovers nevertheless very significant fragments; and these fragments of universal truth are precisely what constitutes science.

CLAUDE BERNARD INTRODUCTION TO THE STUDY OF EXPERIMENTAL MEDICINE pdf

7: Turbid urine and beef-eating rabbits: Claude Bernard (â€“78)â€”a founder of modern physiology

Born in France, in , Claude Bernard was the founder of modern experimental physiology. At Lyon, he studied to become a playwright, but critics' rejection of his works ended his dramatic aspirations.

Advanced Search Abstract This article explores the profound impact of the thought of Claude Bernard â€”78 and his philosophy of experimentalism elaborated in his masterwork An Introduction to the Study of Experimental Medicine. This includes his influence on Henri Bergson â€” and other late-nineteenth century thinkers. In contrast to much of mid-nineteenth-century philosophy, Bernard, in creating the framework for experimental medicine, argued for an experimental approach in which a priori assumptions were to be strictly constrained. It is no surprise that Gillispie was also chief editor of the monumental biographical reference that still stands as a classic research tool in the history of scienceâ€"the Dictionary of Scientific Biography. For Gillispie, science was a decidedly progressive endeavor, and its modern incarnation was the final end point and justification for this claim. His lectures and discussions with students evolved into a book, published in in the early, heady days of the DNA revolution, entitled The Edge of Objectivity: An Essay in the History of Scientific Ideas. It is a science of nature, and the boundary between life and nature becomes one of narrowing ignorance rather than of principle. Quite generally, indeed, the historical movement of modern science has transferred the arena where unity reigns from nature into science itself, until in positivism the ancient assertion that there are no boundaries or jumps applies rather to science than to the nature it objectifies, or alienates, or even as romantics would say annihilates. Seeing Bernard as the archetypal experimentalist, Gillispie argued that the questions of evolution and development were of precious little interest to him: Claude Bernard, perhaps the greatest of experimentalists in his skill and sobriety, saw the future of biology as lying in its reduction in physiology to laws of chemistry and physics. There was nothing for him in Darwin, whose work he did not distinguish from Naturphilosophie. He never thought this science. I argue that the portrayal of Bernard as a simple experimentalist is a broad characterization in need of important refinements. For one, Bernard was a pioneer in the epistemology of the life sciences in much the same way as Newton in the epistemology of the physical sciences. This is to say that he struggled with the idea of causality deeply, rather than simply enumerating multiple effects. Further, it will show that the schism between mechanism and vitalism is essential to any meaningful understanding of nineteenth-century biology and medicine, placing it in the proper admittedly historicist context of philosophical and ideological debate. Historians like Canguilhem apply a deep epistemological sophistication to Bernard and avoid falling into the positivist trap. As such, they will be emphasized and carefully considered. Historiographically, Bernard leaves a divided legacy between materialism and spiritualism, positivism and skepticism, certainty and doubt. Bernard has been seen in a number of different lights, as public figure and propagandist for the cause of experimental medicine, as sophisticated epistemologist and proponent of a complex philosophy of the life sciences, as mechanist and materialist and also as a kind of neo-vitalist. It has been argued that Bernard owes his greatest philosophical debt to Descartes. We might ask, however, in what sense Bernard is influenced by Cartesian dualism. Is his intermediary position between materialism and spiritualism a result of his responding to the mindâ€"body duality of Descartes, or is it a kind of dynamic monism or even a neo-vitalism, that is to say a much more nuanced, subtle appreciation of the many and various interactions and interconnections between the psychological or psychic and the physiological? It is for this reason that his affinity with vitalism can be seen as largely founded on epistemological grounds. Unlike earlier physiological thinkers, however, the idea of an immaterial, incorporeal vital force is anathema to Bernard. And as we will see, Bernard also spends time addressing the concerns of Comtean positivism. As one historian notes, this is one of the major ideas in regulatory physiology. Like earlier vitalists, Bernard was interested in the notion that organisms could regulate their functions independent of physical environment. It is this doubt about experimental control that leads Bernard to favor a fundamental principle of vitalismâ€"the distinction between organic and inorganic. Bergson freely acknowledged the influence of Spencer on his thinking, despite the challenges he levels at him, and it is the continued spread of the Darwinian creed, which Spencer represents, that Bergson grapples with, always eager to make its fundamental importance to vitalism known. His biographical details, however, have often been naively portrayed as anticipating his experimentalism and his sympathy towards positivism. Immersing himself more meaningfully in his studies, he was first attracted to literature. Perhaps this planted the positivist seed in Bernard as the only reasonable response, but this motivation seems overstated, particularly when it was not altogether clear at this point that he would be headed into medical practice. More than anything, Bernard appears possessed of an affinity for practicalityâ€”a pronounced feature of his post-literary life. His decision to abandon writing as a profession in favor of medical school illustrates this inclination. Playwright, physician, physiologist, and philosopher; Bernard was all these things. It is unfortunate that in an effort to preserve an ill-fitting positivist garb, a simplistic and forward-looking history has been sewn with only tattered bits and pieces of a rich whole cloth. And yet, in a fundamental way, he approached his craft from a very exalted theoretical height. It is this philosopherâ€”scientist duality that is so compelling in Bernard. If we are to analyze Bernard from the point of view of his objectives, his reported actions, and the chaos and trauma they created in his life, then a few intellectual strategies come into prominent relief. Bernard, an arch-experimentalist, resorts to history first to rationalize vivisection. He looks back to Galen and the ancients in discussing the origins of vivisectionist practice. His active, operative, and experimental stance is a far cry from the passive observational view that is one of the hallmarks of earlier vitalist visions. From Aristotle and Hippocrates to late-eighteenth and early-nineteenth century vitalists like Bichat, observation was the main programmatic model of the clinic. It was through pathological anatomy and dissection that advances in the medical arts had been charted. There are, of course, exceptions to the historical dominance of this approach, but they are notable for their relative rarity. He even goes so far as to criticize the limitations of the observational method when he discusses anatomy. To Bernard, gross categorization developed in this way leads one only so far. This is, in a sense, a developing distinction between form and function, the first figuring only loosely into the core experimental drive of physiological research. In Experimental Medicine, Bernard places physiology at the end of a progressive list, making it clear that the new science does not overly concern itself with distinctions in form between species; rather it makes life i. Roll-Hansen sees both Kant and Bernard as challenging methodological reductionism. According to Roll-Hansen, Kant freely admits that there are limits to the absolute theoretical knowledge system i. In contrast to his forward-looking, Newtonian view of the physical sciences, Kant has a view of biology that is, in a way, decidedly Aristotelian. Of particular importance in Kantian biology is the importance of purpose and direction teleology. The idea that living things possess a capacity to transcend the perfect collisions and inertia of a simple mechanistic Newtonian system leads Kant to doubt that this basic description of the physical world as all encompassing. In essence, Kant sees limits to a mechanical understanding of living things. From this assumption one also derives a Kantian critique of reductionism, even an anti-reductionism, in his contrast between the mechanical and the teleological. Roll-Hansen argues that Bernard, like Kant, also sees restraints on the scientific understanding of life, and he disputes the many portrayals of Bernard that place undue influence on his methodology i. As such, Roll-Hansen explores a number of instances where Bernard has doubts about the experimental method. This interpretation of positivism, as merely a philosophical reflection of the methodological principles of good observational-based science, misses a deep ideological and rhetorical design behind the movement. Bernard, we will see, is certainly not averse to theoretical and metaphysical speculation, and further, his ever cautious, even skeptical approach to scientific method also suggests difficulties with the positivist straitjacket that Charlton wants to tailor for him. If Bernard is anything, he is an experimentalist. Positivism is merely one of many philosophical systems worthy of consideration. Holmes carefully but unsatisfyingly prefaces an argument about Bernard with the following: In Experimental Medicine, Bernard makes it clear he wants to move beyond the strictures and structures that have confined medicine for centuries. The lynchpin of this analytical approach is, of course, experiment. As the book begins, Bernard lays out his view of the basic elements of medicine, consisting of physiology, pathology, and therapeutics. He then quickly switches his focus back to the importance of experimentalism. Creating a distinction between observation and experiment, Bernard further reduces these approaches to a passive and active interaction with nature, and, in the case of medicine, to some degree between acting and not acting on the body. He also wants to show how the two methods are related. It is this view that leads Bernard to conclude there is no real difference between the pathological an understanding of which is derived from observational sciences like anatomy and the physiological where Bernard sees experiment as essential to comprehension , and that both are subject to a universal scientific approach. Here again, however, there is a contingency allowing for the uniqueness of vital phenomena: Thus, for him, anticipation and preconception always precede experience. It is experiment, however, that transforms a priori conception into a posteriori interpretation. Moreover, in what can only be characterized as a Comtean conception of intellectual development, Bernard sees the clear and successive evolution of the human mind moving through three stages: At a basic level, man was guided by feeling, and intuition was the most powerful framework for understanding. From this one moves to pure reasonâ€”the deductive methodâ€"to experiment, which is essentially inductive. Experiment is not pure induction, however, and is compared with getting to the root of human behavior, rather than judging from outward appearances. For Bernard, experiment is the mediator between the objective and the subjective. To Bernard, the great difference between the skeptic and the doubter i. In this sense, Bernard is not unlike the alchemists of the early modern period. On one level, this is due to the unpredictability inherent in the living, which is cited as a limit to the experimental approach. Every living being indeed appears to us provided with a kind of inner force, which presides over manifestations of life more and more independent of general cosmic influence in proportion as the being rises higher in the scale of organization. In the higher animals and in man, this vital force seems to result in withdrawing the living being from general physico-chemical influences and thus making the experimental approach very difficult. Thus, they are easily subject to experiment. All parts of a living body are interrelated; they can act only in so far as they act all together; trying to separate one from the whole means transferring it to the realm of dead substances; it means entirely changing its essence. His ultimately empirical position at this point leads to some startling statements: Confidence in absolute determinism in the phenomena of life leads, on the contrary, to real science, and gives the modesty [that] comes from the consciousness of our little learning and the difficulty of science. This feeling incites us, in turn, to work toward knowledge; and to this feeling alone, science owes all its progress. The milieu, with its arguably Hippocratic roots, was interpreted quite broadly by Bernard. In emphasizing the role of the internal environment, Bernard tended to downplay external vectors of disease. He argued that viruses were produced under the influence of the nervous system, and even suggested that there were cases of spontaneous manifestation. It is here, in the intersection between organism and milieu, where an understanding of disease is found. We see here a clear recognition of the inherent complexity of the living organism and a critique of the seemingly objective results of experiments within limited parameters. A living machine keeps up its movement because the inner mechanism of the organism, by acts and forces ceaselessly renewed, repairs the losses involved in the exercise of its functions. Machines created by the intelligence of man, though infinitely coarser, are built in just such a fashion. It is in this vein that his role as a transitional figure becomes clear. The vital force as conceived of by late eighteenth-century figures like Barthez is anathema to Bernard, but there is a clear understanding in his work of what will become some of the most important principles of vitalism and organicism in the late nineteeth and early twentieth century.

CLAUDE BERNARD INTRODUCTION TO THE STUDY OF EXPERIMENTAL MEDICINE pdf

8: An Introduction To the Study Of Experimental Medicine by Bernard, Claude

Claude Bernard on the Limitations of Experimental Biology," J. Hist. Biol., , 9, For a recent example of the kind of positivist inspired history of scientiï¬•c medicine men- tioned above see William Bynum, Science and the Practice of Medicine in the Nineteenth Century.

Any explanation of the phenomena of life based exclusively on anatomical considerations is necessarily incomplete. Anterior view of the superficial muscles of the trunk. Bernard was an excellent chemist. He admired the discoveries made by Antoine Laurent de Lavoisier and Pierre de Laplace He also studied the biochemistry of fats with his chemist friend Marcellin Berthelot In his doctoral thesis on the role of gastric juice in digestion, he used his chemistry training to measure fasting and postprandial gastric acidity. The Germans reciprocated by considering Claude Bernard an impulsive and romantic experimentalist over inclined to generalization. It ends up making everything the same, leaving us with effects without causes. Grmek, who tracked and unraveled the innermost thoughts and intellectual trajectoryâ€" marked by failure, frustration, and successâ€"of a man in search of truth. Determined to pursue his research in the absence of any preconceived ideas and to keep his mind entirely free, Claude Bernard worked on several fronts simultaneously. Comparing and contrasting his experiences and experiments, he was always reworking his notes and observations in the conviction that knowledge constantly progressed and evolved over time. Marcellin Berthelot in his laboratory. Wood engraving by Guth and Florian. Later, with Charles Barres will, he chemically identified glycogen as the precursor of glucose. His doctor of science thesis on hepatic glycogenesis paved the way for enzymology. The publication in of his Report on the pancreas and the role of pancreatic juice in digestion marked the first stage of his studies in nutrition. He discovered the function of bile in protein digestion and in published his Lectures and physiological experiments on nutrition. However, he was wrong about the site of action of curare, locating it at the distal extremity of the motor nerve. He explained the role of red blood cells in respiration, showing that oxygen bound to hemoglobin: In addition to his unfinished studies on the anatomy and physiology of the chorda tympani, he described in particular the role of vagal inhibition of the heart, and the vasoconstrictor and vasodilator nerves of the sympathetic system. In , he published his Lectures on the physiology and pathology of the nervous system. He built it brick by brick between and He expounded the concept in December In each case we find ourselves in the presence of a genius who began by making great discoveries and then wondered how one had to proceed in order to have done so: Claude Bernard also set physiology apart from the empiricism of medicine by endowing it with its own concepts developed through specific methods of investigation. It is absolutely essential to get down to the details. The book was not translated into English until , into Spanish in , and into German in To deny this would amount to nothing less than denying science itself. Because Nature only allows a limited number of facts to be observed, these need to be prolonged or evoked by experiment. By combining with chemistry, physics, and all the exact sciences, physiology becomes able to be explain all living phenomena, whether normal or pathological. However, he came up against the hostility of the Academy of Medicine, for whom the primacy of the anatomo-clinical methodâ€"another great pride of 19th century French medicineâ€" was sacrosanct. Claude Bernard versus Louis Pasteur: On November 7, he published an article in Le Moniteur Universel: This book is barely known because written at a level that few these days can reach. We must have been born to get along together as we are both driven by the same passion and same feelings for true science. Pasteur wants to direct Nature, whereas I let Nature direct me: Pasteur immediately threw back at Claude Bernard the accusation that he was using a system-based approach. In reality the two men disagreed on the factors and conditions for alcoholic fermentation. Having devoted many years of his life to this question one of national interest , Pasteur attributed the transformation of sugar into alcohol under anaerobic conditions to the presence of microorganisms. His notes on alcoholic fermentation were published in July by the chemist Marcellin Berthelot, five months after his death; they aroused the wrath of Pasteur. This dispute between the two giants of French science raised the whole question of modern biology. For Claude Bernard, a functioning live organism was an organism that destroyed itself by itself little by little via physicochemical phenomena tending towards death. Cahier de notes [Notebooks]. Physiology and experimental medicine. Grmek MD, Fantini B, eds. 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