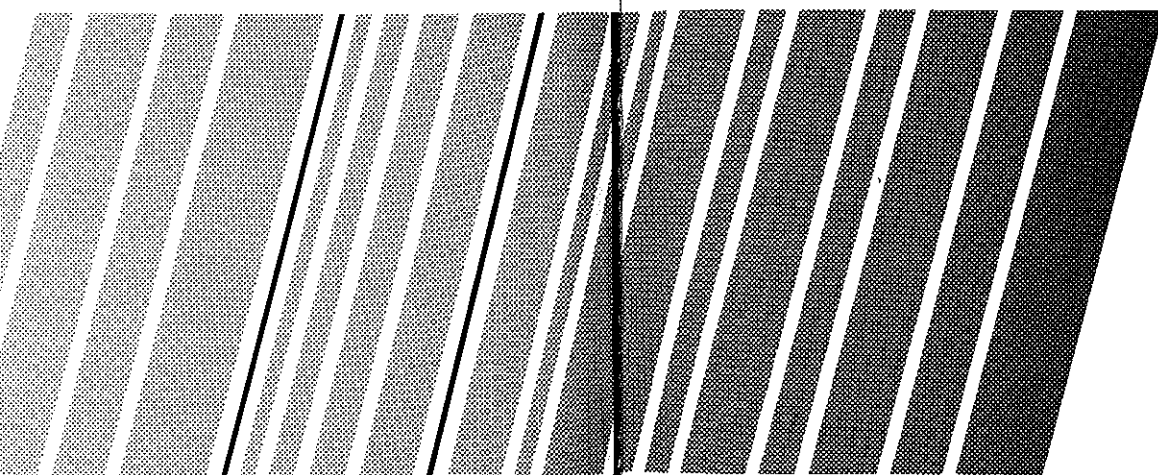

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Genesis and Development of a Scientific Fact

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A scientific fact taken from the annals of medicine is particularly suitable for our observations, because it is very rich in history and content but has not yet been thoroughly examined epistemologically.

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Prologue

What is a fact?

A fact is supposed to be distinguished from transient theories as something definite, permanent, and independent of any subjective interpretation by the scientist. It is that which the various scientific disciplines aim at. The critique of the methods used to establish it constitutes the subject matter of epistemology.

Epistemology often commits a fundamental error: almost exclusively it regards well-established facts of everyday life, or those of classical physics, as the only ones that are reliable and worthy of investigation. Valuation based upon such an investigation is inherently naive, with the result that only superficial data are obtained.

Moreover, we have even lost any critical insight we may once have had into the organic basis of perception, taking for granted the basic fact that a normal person has two eyes. We have nearly ceased to consider this as even knowledge at all and are no longer conscious of our own participation in perception. Instead, we feel a complete passivity in the face of a power that is independent of us; a power we call "existence" or "reality." In this respect we behave like someone who daily performs ritual or habitual actions mechanically. These are no longer voluntary activities, but ones which we

(Hardy)

feel compelled to perform to the exclusion of others. A better analogy perhaps is the behavior of a person taking part in a mass movement. Consider, for instance, a casual visitor to the Stock Exchange, who feels the panic selling in a bear market as only an external force existing in reality. He is completely unaware of his own excitement in the throng and hence does not realize how much he may be contributing to the general state.* Long-established facts of everyday life, then, do not lend themselves to epistemological investigation.

As for the facts of classical physics, here too we are handicapped by being accustomed to them in practice and by the facts themselves being well worn theoretically. I therefore believe that a "more recent fact," discovered not in the remote past and not yet exhausted for epistemological purposes, will conform best to the principles of unbiased investigation. A medical fact, the importance and applicability of which cannot be denied, is particularly suitable, because it also appears to be very rewarding historically and phenomenologically. I have therefore selected one of the best established medical facts: the fact that the so-called Wassermann reaction is related to syphilis.

HOW, THEN, DID THIS EMPIRICAL FACT ORIGINATE AND IN WHAT DOES IT CONSIST?

Lvov, Poland, summer 1934

*"Those who join a panic make a panic." H. G. Wells, 1916.—Eds.

One

How the Modern Concept of Syphilis Originated

The historical sources of syphilology can be traced back, without a break, to the end of the fifteenth century. They contain descriptions of a more or less differentiated specific disease (in modern terms a so-called *disease entity*) which historically corresponds to our concept of syphilis, although the bounds and nomenclature have undergone considerable modification. The symptomatology of the disease also underwent a similar transformation. Toward the end of the fifteenth century the line of development in the diagnosis of syphilis disappears from our view into an undifferentiated and confused mass of information about chronic diseases characterized by skin symptoms frequently localized in the genitals—diseases that sometimes assumed epidemic proportions.

Within this primitive jumble of the most diverse diseases, which crystallized during the following centuries into various entities, we can detect in addition to syphilis what we now call leprosy; scabies; tuberculosis of the skin, bone, and glands; small pox (variola); mycoses of the skin; gonorrhea, soft chancre, probably also lymphogranuloma inguinale, and many skin diseases still regarded as nonspecific today, as well as general constitutional illnesses such as gout.

The confused political conditions prevailing in Europe at the

close of the fifteenth century with wars, famine and natural disasters, such as extreme heat and floods affecting many localities, resulted in a dreadful accumulation of divers epidemics and diseases.¹ These occurred with such frequency and brought such fearful misery that the attention of research workers was increased, initiating the development of syphilological thought.

One particular circumstance above all others, namely the astrological constellation, if not father to this thought at least sired one of its constituents. "Most authors assume that the conjunction of Saturn and Jupiter under the sign of Scorpio and the House of Mars on 25.XI.1484 was the cause of the carnal scourge [*Lust-seuche*]. Benign Jupiter was vanquished by the evil planets Saturn and Mars. The sign of Scorpio, which rules the genitals, explains why the genitals were the first place to be attacked by the new disease."²

Astrology played a dominant role at the time, which readily explains why the astrological interpretation of the origin of syphilis had such a persuasive effect upon then-current research. One also finds that almost all the authors of that period hint at the sidereal origin of syphilis as the first and most important cause of the epidemic. "Furthermore, the condition here mostly affects the genitals initially, spreading from there to the whole body, *and no other disease is found that starts in this way*. But I guess that this is brought about by some affinity between the genitals and this disease. This may derive from some celestial effect, as the astrologers claim, arising from the conjunction of Saturn and Jupiter in the third aspect of Scorpio in the 23d degree in 1484 as well as from a simultaneous configuration of other fixed stars which just happened to occur then. Over long stretches of time many diseases were seen to arise, as well as old ones to die out, as we shall clearly show later. Not only is the origin of this disease traced to the position of the stars, but the disease is fomented again and again especially by the sign of Scorpio, which rules the genitals."³

The explanation given to any relation can survive and develop within a given society only if this explanation is stylized in conformity with the prevailing thought style. Astrology thus contributed its share to the firm establishment of the venereal character of syphilis as its first "specific difference." Religious teachings, claiming

that the disease is a punishment for sinful lust and that sexual intercourse has special ethical significance, finally established this cornerstone of syphilology, ascribing to it a pronounced ethical character. "Some refer the cause of the disease to God, Who has sent it because He wants Mankind to shun the sin of fornication."⁴

If the epidemic provided the subject matter for an investigation, the resulting emergency stimulated it. Astrology was the dominant science, and religion created a mystical frame of mind. Together these produced that sociopsychological prevailing attitude which for centuries favored the isolation and consistent fixation upon the emotive venereal character of this newly determined disease entity. The stigma of fatefulness and sinfulness was imprinted upon syphilis—a stigma which it still carries within large sectors of the public.

This rudimentary idea in syphilology, involving a theory of the venereal nature of syphilis,⁵ or syphilis construed simply as the carnal scourge, seems far too broadly based. It comprises not only what we today call syphilis but also the other venereal diseases, which have so far been successively distinguished as gonorrhea, soft chancre, and lymphogranuloma inguinale. However, the sociopsychological and historical foundation was so strong that it took four centuries before scientific advances in other fields were important enough to establish a definitive distinction among these various diseases. Such entrenchment of thought proves that it was not so-called empirical observations that led to the construction and fixation of the idea. Instead, special factors of deep psychological and traditional significance greatly contributed to it.

This first feature in the emergent science of syphilology began to establish itself toward the end of the fifteenth and during the course of the sixteenth century. But it did not remain the only one. Three other ideas, originating in other social strata and during other eras, interacted with it. Only through this interaction, the cooperation and opposition among these ideas, has the definition of syphilis as a disease entity been advanced to its present level.

The second idea evolved from medical practitioners using pharmaceutical resources. Sudhoff comments: "As a result of decades of practice, certainly spanning several generations, it became possible to distinguish and isolate from the host of chronic skin

conditions a particular group which, when treated with mercury ointment, reacted favorably, indeed was completely cured.... This therapeutic finding was also taken up by the internal specialists. During the middle of the fourteenth century we encounter for the first time a comprehensive designation of those chronic skin diseases that can be cured by treatment with this general mercurial embrocation. These were distinguished from the many variants of scabies, namely chronic eczema and related skin diseases such as scabies grossa."⁶

Sudhoff regards the use of mercury, which is rooted in very ancient metallothrapy, as the true and only origin of the syphilis concept. But this theory seems to me to be incorrect. Some early treatises on the subject consider syphilis a disease entity but do not even mention mercury. Second, mercury was a popular remedy for many other diseases of the skin such as scabies and leprosy. Third, if the curative effect of mercury were alone decisive, other venereal diseases such as gonorrhea and soft chancre should not have become related to syphilis at all, since these remain unaffected by mercury. The curative effect of Hg seems therefore to be only a secondary factor in the establishment of the concept of syphilis.

Its importance must nevertheless not be underrated, for the use of mercury in the treatment of syphilis was very widespread. It is said, for instance, that "metallic remedies are mainly mercury" or that a particular "substance is combined with these metals, mostly with mercury, although I use cinnabar more than sublimate."⁷ Remarkably, even the flow of toxic saliva during mercury treatment was considered to be a therapeutic effect involving the "evacuation" of the syphilis toxin. Such an evacuation occurs "mainly through the sputum, and nothing is more efficacious than mercury in promoting it."⁸

The use of mercury in treating syphilis has been traditionally regarded as natural. Although it presented the risk of poisoning, it was nevertheless felt that "mercury is noble, useful in many fields, and necessary."⁹ As time went on, the effect of Hg became increasingly recognized and mercury was also used as a diagnostic aid.

But even as late as the nineteenth century it was still not possible to settle upon a satisfactory concept of syphilis on the basis of Hg

alone. In accordance with the idea of carnal scourge, syphilis was thought to include other venereal diseases such as gonorrhea and soft chancre and their complications. These, as well as local diseases of the genitals, such as balanitis, which are regarded as nonspecific even today, were later differentiated on the basis of pathogenesis and etiology. These latter conditions, however, remain unaffected by mercury. So to combine both points of view, that of mercury and that of carnal scourge, it was observed that "sometimes mercury does not cure the carnal scourge but makes it even worse."¹⁰ This neatly resolved the dilemma. The mercury idea really concerned the diagnosis only of so-called constitutional syphilis, that is, the stage of the generalized disease. The primary stage, properly venereal because it is localized in the genitals, remained untouched by that idea and was characterized by the idea of the carnal scourge. Thus two points of view developed side by side, together, often at odds with each other: (1) an ethical-mystical disease entity of "carnal scourge," and (2) an empirical-therapeutic disease entity. Neither of these points of view was adhered to consistently. Although mutually contradictory, they eventually became amalgamated. Theoretical and practical elements, the a priori and the purely empirical, mingled with one another according to the rules not of logic but of psychology. Empiricism was largely displaced by an emotive apriority. Some physicians even doubted the existence of syphilis altogether. In a sixteenth-century treatise it is claimed that "quite a few therefore state that there is no such thing as the French pox, except in the imagination of some of our contemporaries. For they say that what we call the French pox constitutes a variety of conditions."¹¹

There were those who doubted it even as late as the end of the nineteenth century. Dr. Josef Hermann, for many years (1858-88) physician-in-chief and head of the department of syphilis at the Imperial and Royal Hospital of Wieden in Vienna, published a pamphlet about 1890 entitled *Constitutional Syphilis Does Not Exist*.¹² In his view syphilis is a "simple, local disease which never spreads to the human blood, is completely curable, never leaves permanent effects, and is never propagated by procreation and heredity." It manifests itself through chancre or gonorrhea "and by all the direct sequelae of these two primitive conditions." On the

other hand, there is a "veritable host of disease manifestations which profoundly affect the social life of humanity and even the entire generation. But all these general symptoms do not constitute syphilis at all. They are exclusively produced either by the mercury treatment itself or by other bad concoctions." To Hermann, syphilis still meant the original carnal scourge [*Lustseuche*], construed as only a localized disease without general symptoms. A general syphilitic condition would have the presence of syphilis in the blood as a "first premise," but "the existence of syphilitic blood is only a dogmatic precept without the slightest evidence to support it." Hermann declared that "no pathognomonic indication of syphilis will ever be found in the blood of those suffering from this disease."

Although his views appear to have been fossilized as measured even by the standards of his time, this outsider is of particular importance in our investigation for the following reason. He attested to just how strongly syphilis and Hg had become associated with one another, and also emphasized the quandary in which the physicians found themselves because of the pleomorphism of the syphilis symptoms. This in turn produced a general and urgent "demand for blood tests" as the means to identify this disease entity with precision.¹³

The concept of syphilis, then, was still vague and incomplete. The two approaches to it contradicted each other. The clash was felt all the more clearly to the extent that the primitive ethical-mystical idea lost its fascination owing to changes in the general thought style and as more details of the relevant phenomena were brought to light. But the concept still remained too variable, and not sufficiently entwined or interwoven within the fabric of contemporary knowledge to be considered finally established with a firmly based, objective existence, and thus to appear as an undoubtedly "real fact."

The intellectual clarity of the issue, in particular, was clouded because several important factors were disregarded. No attempt was made to differentiate between venereal diseases with general symptoms and those either lacking them altogether or, like gonorrhea, rarely exhibiting them. Hereditary syphilis and the inferior quality of the offspring of syphilitic parents were also problems; as were the unsolved puzzle of latent syphilis, the reappearance of

the disease, and also its variously suspected relation to many other diseases such as tabes and progressive paralysis, lupus, and scrophulosis. In general, the era of experiments and wide-ranging knowledge developed in detail had already begun. History records an abundance of experiments and observations about inoculations, reinoculations, and immunity relations. But it would be wrong to think that experiments, no matter how clearly conceived, always produced the "correct" results. Although important as starting points for new methods, these were worthless as evidence.

An argument developed between those who believed in the identity of gonorrhea, syphilis, and soft chancre (the "theory of identity") and the physicians who wanted to divide the great pox into several disease entities. "Several physicians, especially Andree and Swediauer, attempted to establish the identity of the infective material of the two diseases on the basis of the gonorrheic mucus and the chancre pus. After a few experiments conducted with these substances it was claimed that the gonorrheic toxin could sometimes produce chancre and vice versa—a view which was widely adopted. Fritze thought that the two conditions differed specifically but not generically,"¹⁴ since with some organisms the pathogenic substance "was too weak to produce chancre, although still strong enough to produce gonorrhea." Hunter¹⁵ inoculated the skin of a healthy person's genitals with gonorrheic pus and obtained an ulcer followed by typical syphilis. Although he maintained the identity of gonorrhea with syphilis, he differentiated between soft and hard (indurated) chancre; the latter alone was supposed to be part of the syphilis complex (the "theory of duality"). A theory of pseudosyphilis grew out of the distinction. This involved a disease resembling syphilis, although it was in fact fundamentally different and not preceded by hard chancre.

Another school differentiated the gonorrheic toxin from that of syphilis, but regarded gonorrhea as the primary stage of a general constitutional disease designated the "gonorrhea disease." This indicates the influence of the theory of syphilis. The "unitarians" (Ricord),¹⁶ yet another school at the time, completely separated gonorrhea from syphilis. They insisted, however, that both hard and soft chancre were identical and spoke of a special predisposition to general syphilitic afflictions, necessary for the general stage

to succeed chancre. Finally, the "new theory of duality"¹⁷ clearly differentiated both gonorrhea and soft chancre from syphilis.

All these observations refer only to the question how to distinguish among various venereal diseases. By no means does it concern the whole complex of problems regarding the syphilis concept—for instance, its relation to tabes or to progressive paralysis. These latter problems were not tackled until pathogenesis and etiology had become sufficiently developed during the second half of the nineteenth and the early twentieth century.

If we consider purely theoretically the viewpoint held during the eighteenth and the first half of the nineteenth century, we must make the following observations.

The concept of syphilis concerns us here only insofar as it alone can indicate the relation between syphilis and the Wassermann reaction; but the concept is also defined in turn by statements that connect a certain number of other concepts. If we look at the various concepts of syphilis described here—(1) the concept of carnal scourge; (2) the empirical-therapeutic concept (mercury); (3) the experimental-pathological concepts of (a) the unitarians, (b) the dualists, (c) the adherents of the identity theory, and so on—just in terms of formal structure, independently of cultural-historical connections, it might seem at first glance to involve only an argument about a conventional definition. All these points of view are based upon observation, perhaps even upon experiments, and none can simply be declared wrong. Yet, if syphilis can be defined in various ways, the definition selected still determines some conclusions. In this respect a certain amount of latitude appears to exist. It is only after the choice has been made that the associations produced by it are seen as necessary. As is well known, this is a viewpoint held by the conventionalists. For instance, it is a matter of free choice to define syphilis or the great pox simply as the carnal scourge. But this would necessarily imply the inclusion of gonorrhea, soft chancre and so on, as well as the abandonment of a therapeutic complex, and possibly of a rational method of treatment altogether. Alternatively a definition could be constructed that is based on the usefulness of Hg. A very practical therapeutic concept would thus be obtained for what we now call the primary and secondary stages, but the tertiary stage and the metasyphilitic

diseases would be excluded from this relation. Although the unitarians and others would be obliged to accept a very complicated convention, even here a description could be constructed that is congruent with their postulates.

From this formal point of view, therefore, there are some associations which are open to choice, that is, free associations, and others that are constrained. Those who recognize economy of thought¹⁸ as the intention to choose from among the active free associations are guided by the theory of Mach.

First, the adherents of all these formal points of view pay far too little, if any, attention to the cultural-historical dependence of such an alleged epistemological choice—the alleged convention. Sixteenth-century physicians were by no means at liberty to replace the mystical-ethical concept of syphilis with one based upon natural science and pathogenesis. A stylistic bond exists between many, if not all, concepts of a period, based on their mutual influence. We can therefore speak of a thought style which determines the formulation of every concept. History shows that violent arguments can rage over the definition of concepts. This demonstrates quite independently of any utilitarian reasons just how little such conventions, which from the point of view of logic may seem equally possible, are in fact felt to be of equal value.

Second, we can find specific historical laws governing the development of ideas, that is, characteristic general phenomena concerning the history of knowledge, which become evident to anyone who examines the development of ideas. For instance, many theories pass through two periods: a classical one during which everything is in striking agreement, followed by a second period during which the exceptions begin to come to the fore. It is also evident that some ideas appear far in advance of their rationale and independently of it. Again, the interweaving of a few strands of ideas can produce special phenomena. Last, the more systematically developed, the richer both in detail and in its relations to other branches a given branch of knowledge is, the fewer will be the differences of opinion in it.

If these general cultural-historical relations as well as special ones in the history of knowledge are taken into account, conventionalism will be considerably restricted. Free rational choice or

convention will be replaced by the special conditions of which we have just spoken. Nonetheless, there are always other connections which are also to be found in the content of knowledge that are not explicable in terms either of psychology (both individual and collective) or of history. For this very reason these seem to be "real," "objective," and "true" relations. We call them the passive connections in contrast with the others which we call active. In our history of syphilis the combination of all venereal diseases under the generic concept of carnal scourge was thus an *active association of the phenomena*, explained in terms of cultural history. In contrast, a restriction of the curative effect of mercury in the sentence quoted earlier asserting that "sometimes mercury does not cure the carnal scourge but makes it even worse" represents a *passive association with respect to the act of cognition*. It is of course evident that this passive association alone could not even be formulated if it were not for the concept of carnal scourge and that, incidentally, the very concept of carnal scourge contains passive as well as active elements.

Besides this theory about active and passive associations and their being inevitably united, the history of the development of the syphilis concept thus far shows the limited significance of any single experiment compared with the total experience consisting of experiments, observations, skills, and transformation of concepts available within a given field. Even a heroic "crucial experiment," such as that performed by Hunter, proves nothing, for its result must now be regarded as either an accident or an error. Today we know that greater experience in the field of inoculation would soon have shown Hunter the need to revise his views.

There is, however, a very important difference between experiment and experience thus construed. Whereas an experiment can be interpreted in terms of a simple question and answer, experience must be understood as a complex state of intellectual training based upon the interaction involving the knower, that which he already knows, and that which he has yet to learn. The acquisition of physical and psychological skills, the amassing of a certain number of observations and experiments, the ability to mold concepts, however, introduce all kinds of factors that cannot be regulated by formal logic. Indeed, such interactions as those mentioned

prohibit any systematic treatment of the cognitive process.

There is therefore no *raison d'être* for any speculative epistemology, even if it be regarded as a deduction from several examples. A great deal still remains to be investigated empirically and discovered about the process of cognition.

Returning to our subject and specifically to the further history of the concept of syphilis, we must mention two other ideas which advanced it to its current form. These are the idea of syphilis as a pathogenetic disease entity, in the extended sense of the word, and that of the special etiological entity.

Pathogenetic ideas about syphilis, that is, opinions about the mechanism of the pathological associations, appear in the earliest treatises on syphilis. Almost invariably these were based on the theory of dyscrasia, which involved noxious, foul mixtures of humors. The whole of medicine was dominated by this theory—or rather this empty phrase, for it permitted only about ten possibilities of combination, as if these were sufficient to cover all diseases. It would be beyond the scope of the present work to describe its peripeteia in detail, but one important aspect ought to be emphasized: the idea of foul blood in syphilitics developed from this general theory of the mixture of humors.

"Change in the blood" was a popular phrase used to explain all generalized diseases.¹⁹ Whereas it went progressively out of fashion for other diseases, however, its significance only increased in the case of syphilis.

Originally one could read phrases such as, "Especially when the bones or muscles and nerves are nourished with melancholic blood which, because it is infected with a noxious property, is not properly transformed into a nourishing substance, it thus happens that secretions are greatly increased and where they accumulate are the cause of the pain already mentioned."²⁰ This is an explanation of the ache in the bones of a syphilitic. Again we read, "as during epidemic fevers a mysterious bad quality in the air corrupts the heart itself, the breath, and the blood."²¹ Similarly, "The blood, specifically of the syphilitic, is converted from its good state to a bad and unnatural one."²² Or, "When opened up here, it is clearly seen that scabs and ulcers are beneath the surface. The cause is really excessively hot and thick blood, infected with a poisonous

property."²³ Or, "It is agreed that it is not really different in those that suffer from the French pox, because from the very onset of this disease the blood is befouled by an infection attacking it without festering, and therefore relatively unnoticed."²⁴ Or, "The French pox is a condition caused by a universal infection in the mass of the blood" (Cataneus).²⁵ Or, "The blood, leaving its natural state, is changed" (Fallopio).²⁶

Now syphilis is an extremely pleomorphic disease of many aspects. We often read in early treatises that it is a "proteiform" disease, since with its many forms, it reminds one of "Proteus or Chameleon."²⁷ Bloch writes that there was hardly any disease or symptom that was not attributed to syphilis.²⁸ In the search for a common factor and specific feature, attention was focused on befouled blood.

"Attempts to establish a diagnosis of syphilis on the basis of blood go back to the time when knowledge of the pathology of this disease was acquiring a more definite structure and the enormous complexity of the clinical aspect was becoming more and more obvious."²⁹

"Early on, the infective agent was thought to be an acidic, corrosive fluid which, admixed to the blood, produces the independent form."³⁰ "Later, when it became increasingly accepted that syphilis depends upon modifications in the blood as well as upon other humors,"³¹ the syphilitic rash was regarded as nature's attempt "to find a means to remove the pathogenic substance"³² through the skin. "The French pox consists of boils caused by the varied corruption of humors" (Leoniceus).³³ Recovery was seen as a cleansing or sweetening of the blood. "For the limbs reject, when it arrives, the infected blood that is allocated for their nourishment, and this is expelled from the whole body by natural means through the skin acting like a handkerchief. This is the source of the first onset, a defilement of the skin, which is followed by the growth of putrid blisters as well as roughness and even further defilement of the skin" (Cataneus).³⁴

About 1867 Geigel wrote: "That the blood as the general store of nutrition undergoes certain material changes during the course of syphilis and, furthermore, that these changes are not the same in all phases of syphilis we may correctly conclude from such anom-

alies in the pattern of nutrition as can be explained only on this basis."³⁵

Reich in 1894, after listing all possible and impossible symptoms of syphilis, wrote, "All this is necessarily the outcome of the changed chemistry of the blood." "The blood of syphilitics definitely differs from that of healthy persons, as has already been confirmed indirectly by various manifestations of the disease and demonstrated by E. J. Gautier, who found diminished proportions of water and sodium chloride."³⁶ It was only about this time that the specific idea of syphilitic blood had begun to come into effect.

Hermann, whom we have already met as a kind of asocial outsider who made Homeric onslaughts against the "dogma of syphilitic blood," described a few contemporary experiments, designed to prove the syphilitic change in the blood. So there obviously *were* experimental attempts to transmit syphilis by means of blood.³⁷ "Another argument advanced in favor of syphilitic blood is the allegation that syphilis can be transmitted through cowpox vaccination."³⁸ Hermann also related that, at a meeting of the society of physicians in Vienna on 12 January 1872, "a young son of Aesculapius, Dr. Lortorfer, asserted that the reason why all previous blood tests had not yielded any tangible results was because faulty methods had been used. He claimed to be the discoverer, or, more correctly, the one who postulated the syphilis corpuscles, which were supposed to be present only in the blood of syphilitics and the existence of which in the blood rendered the diagnosis of constitutional syphilis accurate in every respect." But just a few days later this method was proved to be erroneous, because such syphilitic blood corpuscles "were by no means a specific symptom of syphilis." This also indicates that already at the time there was "examination of the blood of syphilitics with all available chemical and microscopical aids."³⁹

Bruck reported on this subject in greater detail. "Even the numerous earlier, biological-chemical examinations of syphilitic blood had failed to yield any diagnostically usable results. After the experiments by Neumann-Konried, Reiss, Stonkovenoff-Seleneff, Liégeois, Malassez, Rille, Oppenheim, and Löwenbach, it was no longer possible to use changes in the number of blood corpuscles or in the hemoglobin and iron content for diagnostic

purposes. Nagelschmidt was unable to confirm reduction in the resistance of the erythrocytes in syphilis, as was claimed by Monod, Verrotti, Sorrentino, and especially by Justus, which is said to manifest itself in a decrease of the hemoglobin content after the first mercury injection. Investigations concerning an increase in the albumin content of syphilitic blood (Ricord, Grassi, and others) and about such factors as reaction changes and freezing point determinations were also unsuccessful. The work of Detre and Sellei on the agglutinability of syphilitic and normal blood belongs to modern immunology. But even this as well as that of Nagelschmidt concerning the effect of syphilis serum on agglutination, hemolysis, and precipitation yielded no practical results."⁴⁰

With amazing and unprecedented persistence, all possible methods were tried to confirm and to realize the traditional concept of syphilitic blood. It was with the so-called Wassermann reaction that success was at long last achieved. This discovery initiated some very important lines of research; and without much exaggeration it can be considered an epoch-making achievement.

First of all, it redefined syphilis, mainly in the secondary and tertiary stage, and especially in the area of so-called metasyphilitic diseases, such as tabes dorsalis and progressive paralysis. This was followed by a solution to the problems of hereditary and of latent syphilis. As a result of close cooperation with research in other fields it also disposed of fanciful relations with other diseases such as phthisis, rickets, and lupus.

But the Wassermann reaction also created and developed a discipline of its own: serology as a science in its own right. The original connection between serology and the Wassermann reaction still survives in popular everyday medical terminology. The Wassermann reaction is often referred to simply as the "serological test."

At the same time the etiological concept of syphilology became effective and was used to define the disease entity in the primary stage. This completes the present-day (!) definition of syphilis.

It is very difficult, if not impossible, to give an accurate historical account of a scientific discipline. Many developing strands of thought intersect and interact with one another. All of these would have to be represented, first, as continuous lines of develop-

ment and, second, in every one of their mutual connections. Third, the main direction of the development, taken as an idealized average, would have to be drawn separately and at the same time. It is as if we wanted to record in writing the natural course of an excited conversation among several persons all speaking simultaneously among themselves and each clamoring to make himself heard, yet which nevertheless permitted a consensus to crystallize. The continuity in time of the line of thought already mapped out must continually be interrupted to introduce other lines. The main line of development often must be held in abeyance to explicate connections. Moreover, a great deal has to be omitted to preserve the idealized main line. Instead of a description of dynamic interactions, one is left with a more or less artificial scheme.

If I wished to trace the crystallization of the idea of a pathogenic agent from that of a mystical-symbolic spirit of the disease and a disease helminth through the idea of a disease poison and the contagium-vivum concept and on to the modern idea of bacteria as causative agents, I would have to begin again in the remote past. I would have to show how the idea of a pathogenic agent first came into contact with that of syphilis, then diverged from it for a time, made renewed contact in a new form, and eventually became permanently linked with it.

But a detailed description of this particular situation is unnecessary, if only because it resembles the development of the idea of syphilitic blood already discussed and offers few new facts to the theory of knowledge. One important difference, however, is worth mentioning. In advance of direct evidence for the existence of specific causative agents, indirect evidence was already available, since the contagious nature of the disease manifested itself in observation as well as in experiments. Analogies were found with other fields of pathology where the idea of a causative agent had already had a favorable effect during an era when bacteria were "popular." The discovery of the causative agent of syphilis is actually to be attributed mainly to bacteriologists active in other fields. Conversely, the Wassermann reaction was a direct result of syphilology and subsequently developed into a separate science—serology.

The discovery of the causative agent, *Spirochaeta pallida*, was

the result of steady, systematic work by civil servants. After various unsuccessful experiments by others to discover the syphilis agent, "J. Siegel in 1904 and 1905 described structures in various contagious diseases—smallpox, foot-and-mouth disease, scarlet fever, and syphilis. He interpreted these as the still unknown agents causing such diseases and believed these must be construed as Protozoa. In view of the importance which would be attached to Siegel's findings, if confirmed, the president of the German Imperial Health Authority, Dr. Koehler, thought it advisable to have an independent criterion of assessment based upon tests to be carried out under the aegis of his own department."⁴¹ "After a meeting under Koehler's chairmanship on 15 February 1905, Dr. Schaudinn, government board official of the Health Authority, accompanied by Dr. Neufeld, the then acting assistant, went to the director of the Royal University Clinic for Skin and Venereal Diseases, Professor Lesser, to enquire on behalf of the president whether Professor Lesser would be prepared to assist the Health Authority with pathological material in its investigations concerning the syphilis agent. Professor Lesser agreed and proposed his senior assistant, staff surgeon Hoffmann, as an additional member of the project." Already on 3 March, Schaudinn had succeeded in detecting, in the fresh tissue fluid of a syphilitic papule, "very delicate, vigorously moving spirochaetes, clearly visible only with the best optical aids." He designated these *Spirochaeta pallida*, distinguishing them from the coarser forms "quite often occurring on the buccal and the genital mucosa." Experiments of transmitting material containing spirochaetes to monkeys soon followed, yielding positive results. Nevertheless, although *Spirochaeta pallida* had already been found "by more than a hundred authors in the most diverse products of syphilis," the Health Authority, where the discovery had actually originated, was very reticent. "A report by the Health Authority dated 12 August 1905, drawn up by Prowazek and checked and signed by Schaudinn as correspondent, addressed to the Secretary of State of the Interior, ventures only that to see in *Spirochaeta pallida* the causative agent of syphilis is a not unjustified conclusion."⁴² This team of civil servants, to which

⁴¹This contrasts with the account of Hoffmann, both in dating and in the sense of certitude exhibited by the group.—Eds.

the title "discoverer of the syphilis agent" should properly be awarded, carried out its work and judged its own results in the very same careful, rational, and conscientious manner in which it is now related by the team's intellectual successors.

From the production of pure cultures of *Spirochaeta pallida* and inoculation experiments with rabbits and monkeys, the idea of this as the causative agent was confirmed.

The modern concept of syphilis was thus fully established. The agents causing gonorrhea and soft chancre had been discovered earlier, so that these two diseases could be excluded from the picture of syphilis. *Spirochaeta pallida*, together with the Wassermann reaction, helped to classify tabes dorsalis and progressive paralysis definitely with syphilis. Since this spirochaete was found in the lymphatic ducts very soon after infection, even the first stage of syphilis was no longer regarded as a localized disease.

The four lines of thought intertwining to form the modern aspect of syphilis continued to develop as follows. Venereal disease, or "lues venerea," dominated and became the generic term. The connection with the sex act was translated from the mystical-ethical domain into straightforward physical terms. Not long ago another disease entity, lymphogranuloma inguinale, was differentiated from syphilis or, at least, more clearly defined. In this case Frei showed that the so-called skin test originating in the tubercle theory takes the place of the Wassermann reaction. Research is currently being conducted into the causative agent. It is very likely that several more venereal disease entities are still waiting to be discovered. We still speak of so-called nonspecific ulcerations of the genitals and in many individual cases the diagnostic difficulties are great. Diagnoses such as pseudo-ulcus molle and pseudo-syphiloma are still used for want of better terms. A few tropical diseases are thought to be sexually transmitted. From the mercury idea a general chemotherapeutic theory arose which has contributed such wonderful remedies as Salvarsan among others. Although applied to many other fields, this theory is still most effective particularly with syphilis and related protozoic diseases.

The further development of the third line of thought—the idea of syphilitic blood—will presently be considered in detail.

A few very important points remain to be made concerning the

idea of the causative agent. Several aspects of the disease are linked to the biological structure of *Spirochaeta pallida*. Special neurotropic and dermatropic viruses are suspected variants of *Spirochaeta pallida* and said to be related to the clinical course of the disease.⁴² Attempts have been made to explain the syphilitic stages and relapses as the manifestation of a kind of generation change within the causative agent. Besides syphilis there are other important phenomena in the fields of pathology and epidemiology, as well as in bacteriology as an independent science, which even after this brief span of time already display a certain divergence between the development of the concept of any disease and that of its causative micro-organism.

A good example is the "infection inapparente" (Nicolle), which progresses without clinical illness and is very important in other diseases, such as typhus. Another, probably related, is that of the completely harmless germ carrier who harbors certain bacteria (diphtheria bacillus, meningococcus, for example) far more often than the associated disease.

The presence of a micro-organism is therefore not identical with its host's feeling ill. Consequently, the idea of the causative agent has lost the overriding importance it enjoyed during the classical period of bacteriology. Early theories, such as Pettenkofer's, are accordingly being revived. Today it can be claimed almost with impunity that the "causative agent" is but one symptom, and not even the most important, among several indicative of a disease; its presence alone is insufficient and because of the ubiquity of many microbes it occurs automatically when other conditions exist.

Theoretical bacteriology has further inherent difficulties. The biological character of *Spirochaeta pallida* is closely related or similar to that of *Spirochaeta cuniculi*, *Spirochaeta pallidula*, *Spirochaeta dentium*, and others. It can be distinguished only by means of tests on animals.⁴³ *Spirochaeta pallida* should therefore be defined by syphilis instead of the other way round. A botanical classification of the spirochaete species is no more successful than that of most other bacteria. To the extent that species can be defined in bacteriology, there is often no convergence between pathology and bacteriology, as shown, for instance, in the theory of vibrios.⁴⁴

An additional factor is the extreme degree of variation in bacteria, which in some families (bacilli of the diphtheria-pseudo-diphtheria group, for example) is so great that, for the time being, classification of such species is out of the question.

Unpredictable fluctuations in virulence, such as transformations of the saprophytes into parasites and vice versa, altogether destroy the relation which initially appeared so simple between a given type of bacterium and its associated disease. Uhlenhuth and Zülzer are said to have recently succeeded in converting harmless water spirochaetes into virulent ones by passing them through guinea pigs.

It therefore cannot be claimed that syphilis is definable epistemologically solely on the basis of *Spirochaeta pallida*. The idea of the syphilis agent leads into uncertainties attending the concept of bacteriological species as such and will thus depend upon whatever future developments there may be in this field.

The development of the concept of syphilis as a specific disease is thus incomplete in principle, involved as it is in subsequent discoveries and new features of pathology, microbiology, and epidemiology.⁴⁵ In the course of time, the character of the concept has changed from the mystical, through the empirical and generally pathogenetical, to the mainly etiological. This transformation has generated a rich fund of fresh detail, and many details of the original theory were lost in the process. So we are currently learning and teaching very little, if anything at all, about the dependence of syphilis upon climate, season, or the general constitution of the patient. Yet earlier writings contain many such observations. As the concept of syphilis changed, however, new problems arose and new fields of knowledge were established, so that nothing here was really completed.

Epistemological Conclusions from the Established History of a Concept

1. General Observations

The history of any scientific concept could be immaterial to those epistemologists who consider, for instance, the errors of Robert Mayer of no significance to the development of the law of conservation of energy.

Against this we would argue that there is probably no such thing as complete error or complete truth. Sooner or later a modification of the law of conservation of energy will prove necessary, and then we will perhaps be obliged to fall back upon an abandoned "error."

Furthermore, whether we like it or not, we can never sever our links with the past, complete with all its errors. It survives in accepted concepts, in the presentation of problems, in the syllabus of formal education, in everyday life, as well as in language and institutions. Concepts are not spontaneously created but are determined by their "ancestors." That which has occurred in the past is a greater cause of insecurity—rather, it only *becomes* a cause of insecurity—when our ties with it remain unconscious and unknown.

Biology taught me that a field undergoing development should be investigated always from the viewpoint of its past development.

Who today would study anatomy without embryology? In exactly the same way epistemology without historical and comparative investigations is no more than an empty play on words or an epistemology of the imagination.

It is nonsense to think that the history of cognition has as little to do with science as, for example, the history of the telephone with telephone conversations. At least three-quarters if not the entire content of science is conditioned by the history of ideas, psychology, and the sociology of ideas and is thus explicable in these terms.

In the context of our special investigation, I believe that the concept of syphilis is unattainable except through a study of its history. It has already been demonstrated here that *Spirochaeta pallida* alone cannot define the disease. Syphilis is not to be formulated as "the disease caused by *Spirochaeta pallida*." On the contrary, *Spirochaeta pallida* must be designated "the micro-organism related to syphilis." Any other definition of this microbe is hopeless, and further, because of the question of germ carriers, cannot serve to define the disease unambiguously.

It is also inadequate to define syphilis phenomenologically rather than conceptually, in the manner that animals and plants might be defined on the basis of their characteristics. For it is naive to think that, although its historical development has been tortuous and complicated, we can today arrive at the concept of the disease entity "syphilis" simply and safely merely by using current techniques of observation and experiment.

This assumption is not admissible even as a thought experiment [*Denkexperiment*]. Current research techniques, after all, are also the result of historical development. They are the way they are because of just this particular history. Even the modern concept of disease entity, for example, is an outcome of precisely such a development and by no means the only logical possibility. As history shows, it is feasible to introduce completely different classifications of diseases. Furthermore, it is possible to dispense with the concept of a disease entity altogether, and to speak only of various symptoms and states, of various patients and incidences. This latter point of view is by no means impracticable because, after all, the various forms and stages as well as the various patients and constitutions must always be treated differently. It is evident that the formation

of the concept "disease entity" involves synthesis as well as analysis, and that the current concept does not constitute the logically or essentially only possible solution.

In this context it is not possible to regard things simply as given. Experience gained over several years of working in the venereal disease section of a large city hospital convinced me that it would never occur even to a modern research worker, equipped with a complete intellectual and material armory, to isolate all these multifarious aspects and sequelae of the disease from the totality of the cases he deals with or to segregate them from complications and lump them together. Only through organized cooperative research, supported by popular knowledge and continuing over several generations, might a unified picture emerge, for the development of the disease phenomena requires decades.

Here, however, training, technical resources and the very nature of collaboration would repeatedly lead research workers back to the historical development of knowledge, since the bonds of history can never be cut.

For epistemology, it might be objected, it is not important to investigate how a connection was discovered, but only to legitimize it scientifically, prove it objectively, and construct it logically. But this could be countered as follows.

Legitimization is certainly very important in science generally and, within reasonable bounds and precision, to our case as well; otherwise syphilology would not be a branch of science. But I do not agree with the view that the sole or even most important task of epistemology consists in this kind of examination of the consistency of concepts and their interconnections within a system.

Whatever is known has always seemed systematic, proven, applicable, and evident to the knower. Every alien system of knowledge has likewise seemed contradictory, unproven, inapplicable, fanciful, or mystical. May not the time have come to assume a less egocentric, more general point of view and to speak of comparative epistemology? A rule of thought that allows one to make use of more details and more compulsory connections, as the history of science teaches us, deserves to be emphasized. I believe that the principles used in the present study render many a neglected relation both visible and suitable for investigation.

The concept of syphilis must be investigated like any other case in the history of ideas, as being a result of the development and confluence of several lines of collective thought.

It is not possible to legitimize the "existence" of syphilis in any other than a historical way. To avoid unnecessary and traditional mysticism it is thus appropriate to use the term "existence" restrictively as only a thinking aid and convenient shortcut.¹ But it would be a gross mistake merely to assert that the syphilis concept could not be attained without the consideration of particular historical connections. We still have to examine possible laws behind these connections and discover operative socio-cognitive forces.

2. Proto-ideas as Guidelines for the Development of any Finding

Many very solidly established scientific facts are undeniably linked, in their development, to prescientific, somewhat hazy, related proto-ideas or pre-ideas, even though such links cannot be substantiated.

We have described a hazy idea of syphilitic changes in the blood and shown that this idea existed centuries before scientific proof was available. Emerging from a chaotic mixture of ideas, it developed over many epochs, becoming more and more substantial and precise. Evidence for it was adduced from various points of view, and a dogma concerning syphilitic blood gradually consolidated. Several research workers, such as Gautier, succumbed to public opinion and claimed to have found proofs which actually were impossible to establish. The entire repertoire of research available at the time was used to an unprecedented degree until the goal was reached. The idea of syphilitic blood thus became scientifically embodied in the Wassermann reaction and subsequently in more simplified reactions. But the proto-idea has survived among the common people, who still refer to syphilitics as having impure blood.

Seen from this point of view, the Wassermann reaction in its relation to syphilis constitutes the modern, scientific expression of an earlier pre-idea which contributed to the concept of syphilis. Other branches of science also have pre-ideas. The pre-idea of

atomic theory stems from Greek antiquity, specifically as taught by Democritus in his original "atomistics." Historians of science such as Paul Kirchberger² and Friedrich Lange agree that "modern atomic theory developed step by step from the atomistics of Democritus."³ It is a constant source of amazement to see just how many features of modern atomic theory were preformed in the theses of these ancient precursors, such as the combination and separation of atoms, mutual gravitational motions and their effects, as well as pressure and collision phenomena.

Theories of the elements and of chemical composition, the law of conservation of matter, the principle of a spherical earth as well as the heliocentric system each underwent a historical development from somewhat hazy proto-ideas. These existed long before any scientific proofs were available and were supported in different ways throughout the intervening period until they received a modern expression.

Very clear ideas about tiny invisible and living agents as causative of diseases were expressed long before the advent of the modern theory of infection and even before the invention of the microscope. A statement from Varro, "Minute animals that cannot be seen by the eye enter the body from the air through the mouth and also through the nose and cause severe diseases," might have come from a popular edition of Flügge's theory of droplet infection.*

I admit that sometimes a proto-idea could be found for a scientific discovery only through casuistry. We would look in vain for such a proto-idea in the case of isomerism or in the gram differentiation of bacteria. Nor must every ancient idea have a historical relation with a later discovery which it happens to resemble. The Aschheim-Zondek test for pregnancy, for example, is probably unrelated to the medieval idea of the possibility of diagnosing virginity or pregnancy from urine. In spite of prolonged investigation, some ideas remained devoid of scientific proof and were eventually discarded. After just such a search for the "absolute," today there is not even a scientific term to denote it clearly.

Can epistemology blandly ignore the fact that many scientific positions steadily developed from proto-ideas which at the time

*Fleck is referring to Flügge's *Die Mikroorganismen* (see Bibliography).—Eds.

were not based upon the type of proof considered valid today? This question should be reflected upon and investigated. But if we may borrow a hypothesis from the prehistory of paleontology, a proto-idea must not be construed as a "freak of nature." Proto-ideas must be regarded as developmental rudiments of modern theories and as originating from a socio-cognitive foundation.

It might be claimed that, whereas a large number of somewhat hazy ideas have emerged throughout history, it is science that has accepted the "right" ones and rejected the "wrong" ones. But this objection is untenable, since it cannot explain why there are so many possible "correct" representations of unknown objects. Implicit in such a view is the claim that the categories of truth and falsehood may be applied to these proto-ideas. But this suggestion is altogether erroneous. Was "befouled blood," "corrupted or melancholic blood," or "excessively hot and thick" the correct idea for syphilis? "Befouled" is not a precise scientific term. Because it is vague and ambiguous, we cannot decide whether it is suitable for syphilis or not. It is not a systematic term as required today, although it was clearly useful as a starting point in the development of a concept. Even the most suitable of the earlier descriptions—"change in the blood"—can no longer be checked for accuracy. The characteristic "change" is too vague, and a "change in the blood" could correspond in one sense or another to almost any condition or disease. Moreover, "syphilis" means something entirely different today from what it meant formerly. The value of such a pre-idea resides neither in its inner logic nor in its "objective" content as such, but solely in the heuristic significance which it has in the natural tendency of development. And there is no doubt that a fact develops step by step from this hazy proto-idea, which is neither right nor wrong.

Concerning other proto-ideas, such as the Greek pre-idea of the atom or that of the elements, we are also unable to decide whether they are right or wrong if they are taken out of their chronological context, because they correspond to a different thought collective and a different thought style. Although such ideas may not conform to modern scientific thought, their originators certainly considered them to be correct.

Any absolute criterion of judgment as to suitability is as invalid for fossilized theories as a chronologically independent criterion

would be for adaptability of some paleontological species. The brontosaurus was as suitably organized for its environment as the modern lizard is for its own. If considered outside its proper environmental context, however, it could not be called either "adapted" or "unadapted."

The development of thought proceeds so much more rapidly than the pace appropriate to paleontology that we continuously witness the occurrence of "mutations" in thought style. The transformation in physics and in its thought style brought about by relativity theory represents such a mutation, as does the adjustment in bacteriology resulting from the theories of variability and cyclogeny. Suddenly we no longer see clearly what is species and what is individual, or how broadly the concept of life cycle is to be taken. What just a few years ago was regarded as a natural event appears to us today as a complex of artefacts. Soon we shall no longer be able to say even whether Koch's theory is correct or not, because new concepts incongruent with Koch's will arise from the present confusion.

Another comparison taken from the area of word origin, as recently conjectured by some psychologists, may perhaps better explain the importance of pre-ideas. "Words were originally not phonetic nexuses arbitrarily assigned to certain objects, such as the word UFA* denoting a German film studio or 'L' denoting self-induction. They actually indicate a transference of experience and objects to a material that can easily be molded and is always available. Linguistic reproduction was therefore originally not a precise assignment according to logic but imagery in the dynamic sense of geometry. The meaning would be immediately implicit in ideophones created in this way."⁴ The actuality of pre-ideas probably permits the assumption of a similar relationship. Mental reproduction would be originally not a clear-cut assignment according to logic, but rather a transference of experience to a material that could easily be molded and would always be available. The connection between reproduction and experience would not be like the conventional relation between a symbol and what it symbolizes, but would reside in a psychological correspondence

*Universum Film AG, which is a studio, like MGM.—Eds.

between the two. Evidence for this would be directly contained in the products of thought [*Denkgebilden*] created in this way.

Words, then, were not originally names for objects. And cognition, at least initially, does not depend upon mental reconstruction and preformation of phenomena or, as Mach taught,⁵ upon the adaptation of thoughts to some arbitrary external facts as revealed to an average person.

Words and ideas are originally phonetic and mental equivalents of the experiences coinciding with them. This explains the magical meaning of words and the dogmatic, reverential meaning of statements.

Such proto-ideas are at first always too broad and insufficiently specialized. According to Hornbostel, ideas—just as word meanings—have a development that proceeds "not through abstraction from the particular to the general, but through differentiation or specialization from the general to the particular."

3. The Tenacity of Systems of Opinion and the Harmony of Illusions; Viewpoints as Autonomous, Style-Permeated Structures [Gebilde]

Once a structurally complete and closed system of opinions consisting of many details and relations has been formed, it offers enduring resistance to anything that contradicts it.

A striking example of this tendency is given by our history of the concept of "carnal scourge" in its prolonged endurance against every new notion. What we are faced with here is not so much simple passivity or mistrust of new ideas as an active approach which can be divided into several stages. (1) A contradiction to the system appears unthinkable. (2) What does not fit into the system remains unseen; (3) alternatively, if it is noticed, either it is kept secret, or (4) laborious efforts are made to explain an exception in terms that do not contradict the system. (5) Despite the legitimate claims of contradictory views, one tends to see, describe, or even illustrate those circumstances which corroborate current views and thereby give them substance.

In the history of scientific knowledge, no formal relation of

logic exists between conceptions and evidence. Evidence conforms to conceptions just as often as conceptions conform to evidence. After all, conceptions are not logical systems, no matter how much they aspire to that status. They are stylized units which either develop or atrophy just as they are or merge with their proofs into others. Analogously to social structures, every age has its own dominant conceptions as well as remnants of past ones and rudiments of those of the future. It is one of the most important tasks in comparative epistemology to find out how conceptions and hazy ideas pass from one thought style to another, how they emerge as spontaneously generated pre-ideas, and how they are preserved as enduring, rigid structures [*Gebilde*] owing to a kind of harmony of illusions. It is only by such a comparison and investigation of the relevant interrelations that we can begin to understand our own era.

To clarify the point a few examples might be mentioned showing the various degrees of tenacity of viewpoints.

1. When a conception permeates a thought collective strongly enough, so that it penetrates as far as everyday life and idiom and has become a viewpoint in the literal sense of the word, any contradiction appears unthinkable and unimaginable. People argued against Columbus: "Could anyone be mad enough to believe that there are antipodes; people standing with their feet opposite our own, who walk with their legs sticking up and their heads hanging down? Is there really a region on earth where things are upside down, where trees grow downward, and where it rains, hails, and snows upward? The delusion that the earth is round is the cause of this foolish fable."

Today we know that the real cause of difficulty here was the absolute meaning of the concepts "up" and "down"—a problem that dissolves under a relativistic formulation. The same difficulty arises even today if such concepts as existence, reality, and truth are used in an absolute sense. To Kant, an unknowable substratum as "things in themselves" was indispensable for sensory appearances: "otherwise we should be landed in the absurd conclusion that there can be appearance without anything that appears."⁶ Wundt concurs by asking, "What can one do with properties and states which are not properties and states of something?"⁷

2. Every comprehensive theory passes first through a classical

stage, when only those facts are recognized which conform to it exactly, and then through a stage with complications, when the exceptions begin to come forward. The great theoretician Paul Ehrlich knew this only too well: "Unfortunately, this differs in no way from all other scientific problems, since it just becomes more and more complicated."⁸ In the end there are often more exceptions than normal instances.

Such a relation exists between classical chemistry and the chemistry of colloids. Colloidal reactions vastly predominate in nature over classical chemical reactions. Nevertheless, like the colloidal reactions, those events which occur with greater frequency have often had to wait longer for scientific discovery. Many aspects of tanning, dyeing, and the production of adhesives, rubber, and explosives do not correspond to the laws of classical chemistry. Furthermore, special laws must be assumed to explain how agricultural soil can retain nutrient salts, which according to classical chemical and physical laws should be washed away freely by the groundwater. All these many "exceptions" went unrecognized for a long time.

Another instructive example is the fate of observations made in 1908 by Bjerrum and Hantzsch. These seemed to contradict the classical theory of electrolytic dissociation and thus had to wait about ten years until they were repeated by other workers. Proper recognition of these observations obtained only after publication of the work of Laue and Bragg. The simple fact went unnoticed that the color of an ionic salt solution can, during dilution, be so modified that the degree of dissociation appears to remain unchanged. Nor was any attention paid to the fact that the addition of CaCl_2 to salt solutions displaces the normal reaction of the mixture in the acid direction.

Take an example from everyday life. At a time when sexuality was equivalent to uncleanness and naïveté to purity, naive children were thought to be asexual. How amusing it is that sexuality could not be recognized in them! Everyone has the experience of having himself been a child and now lives not entirely isolated from children. Yet it took psychoanalysts to discover children's sexuality.

We see the same thing happening in the classical theory of infectious diseases. Every infectious disease was supposed to be

caused by very small living "agents." Nobody could see that these "agents" were also present in healthy persons, because the phenomenon of the germ carrier was not discovered until much later. The variability of micro-organisms was a second shock. At the time when Koch's theory of specificity held complete sway, any variability was unthinkable.⁹ It was only some time later that relevant observations became more frequent. A third shock will be administered to the classical theory of infection by the theory of the filterable virus. It will be shown that invasion by a causative agent, which is the classic cause of infection, is actually an exceptional way to produce an infection.

This particular example well illustrates the important role that the tenacity of closed systems of opinion plays in the operation of cognition [*Erkenntnisphysiologie*]. Cognition proceeds in this and in no other way. Only a classical theory with associated ideas which are plausible (rooted in the given era), closed (limited), and suitable for publication (stylistically relevant) has the strength to advance. Loeffler's bacilli, for instance, would never have been isolated had they first been found in healthy persons. Without a function in an era preoccupied with "causes," this finding would never have attracted the necessary attention nor stimulated the necessary research effort.

Discovery is thus inextricably interwoven with what is known as error. To recognize a certain relation, many another relation must be misunderstood, denied, or overlooked.

The operation of cognition [*Erkenntnisphysiologie*] is analogous to the physiology of movement. To move a limb, an entire so-called myostatic system must be immobilized to provide a basis of fixation. Every movement consists of two active processes; namely, motion and inhibition. The corresponding features in the operation of cognition are purposive, directed determination and cooperative abstraction, which complement one another.

3. We have mentioned concealment of an "exception" among the stages of tenacity in opinion systems. One of many exceptions was the orbital motion of Mercury as related to Newton's laws. Experts in the field were aware of it, but it was concealed from the public because it contradicted prevailing views. It is mentioned only now because it became useful in the context of relativity theory.

4. The very persistence with which observations contradicting a

view are "explained" and smoothed over by conciliators is most instructive. Such effort demonstrates that the aim is logical conformity within a system at any cost, and shows how logic can be interpreted in practice. Every theory aspires to being a logical system but often merely begs the question.

The following passage from Paracelsus is so much to the point here that to quote it here will spare the reader many examples.¹⁰

Man, who alone walks in the visible light of nature, is unable to believe that a man could be possessed by the devil and harbor him in such a way that one must think: This man is *not* a man, but a devil. This possibility arouses revulsion and resentment in any living person. Must it not be a miracle of God that a man living in this world could appear to have a devil?¹¹ Man is supposed to be made in the image of God and not of the devil, who is as different from man as stone from wood. Aside from the fact that man is made in the image of God, he has also been redeemed from the devil by the Son of God. How incredible therefore that nevertheless he can be thrown into such frightful captivity without protection!

Two articles of faith confront each other here, namely, that man could be possessed by the devil, and that yet he was freed from the devil. Neither of these articles may be doubted, but something must be done to save the relevant logic. A miracle of God is invoked to bring them into accord. This saves the logic of the matter and no one need any longer harbor "revulsion and resentment."

No matter how illogical this may appear to us, the whole thing is true to style. Let us try to imagine ourselves in the world of Paracelsus, where every object and event is a symbol, and every symbol and metaphor also has objective value. It is a world full of hidden meanings, spirits, and mysterious powers, full of defiance and awe as well as love and hate. How else could one live in such an impulsive, unsafe, and hazardous reality than to believe in miracles? The miraculous becomes the fundamental principle and most immediate experience within Paracelsian reality and permeates every aspect of his science. It anticipates every consideration, and springs forth from every consideration.

A closed, stylized system of this kind is not immediately receptive to new ideas. These would be reinterpreted to make them conform.

5. The liveliest stage of tenacity in systems of opinion is creative fiction, constituting, as it were, the magical realization of ideas and the interpretation that individual expectations in science are actually fulfilled.

Almost any theory can be quoted as an example here, because all contain some element of wishful thinking by their scientific proponents. But concrete and detailed examples are more useful for illustrating the extent of such wishful thinking than for merely establishing its existence.

In an age when marveling at nature was sufficient to be regarded as knowledge, and before man had learned to utilize his admiration in a practical way to stimulate proper investigation, the purposefulness of things in nature, both living and inanimate, was wondered at and enormously overvalued. Marvelous instincts aroused particular fascination. In an essay "The Nests of Animals" published in 1866, Wood tells the following story.¹² "Maraldi was struck by the great regularity exhibited by bees' honeycombs. He measured the angles of the rhombohedral dividing walls and found them to be $109^{\circ} 28'$ and $70^{\circ} 32'$. Convinced that these particular angles must somehow be related to the economy of the cells, Réaumur asked the mathematician König to calculate what shape a hexagonal vessel bordered by three rhombi would have if it enclosed the maximum volume with minimum surface. Réaumur received the answer that the rhombic angles would have to be $109^{\circ} 26'$ and $70^{\circ} 34'$, constituting a difference of only two minutes of arc. Not satisfied with this lack of agreement, Maclaurin repeated Maraldi's measurements and confirmed them. But when he repeated the calculation he spotted an error in the table of logarithms used by König. It was not the bee but the mathematician that had made the mistake. The bees even helped to discover the error." Mach also comments on this case: "Those who know how to measure crystals, and have seen a honeycomb with its rather rough and non-reflecting surfaces, will doubt that an accuracy of two minutes can be achieved in its measurement. The story must therefore be considered only a doughty legend of mathematics. . . . It must also be said that the mathematical problem had not been fully presented, so there is no way to judge to what extent the bees have actually solved it."

Those who find this story, written as it is in a quite scientific

style,¹³ insufficiently convincing to demonstrate the occurrence of self-fulfilling scientific expectation* [*Wunschtraumerfüllung*], may prefer to look at even "more objective fiction" in the form of pictorial representations.

In an Amsterdam transcription by N. Fontanus¹⁴ of Vesalius's *Epitome*, the uterus is illustrated on page 33, with the following legend on page 32. "Question: How does the seed enter the woman during ejaculation if the womb is so tightly closed that not even a needle can enter through it, according to Hippocrates, book 5, aphorisms 51 and 54? Answer: Through a branch leading from the ejaculatory duct entering the cervix of the uterus, as this illustration shows."

The idea of a fundamental analogy existing between male and female genitals, as held in antiquity, is exhibited most effectively here, and illustrated as if it really occurred in nature. Anatomists will notice immediately that the proportions of the organs, as well as the corresponding positioning, have been restyled to conform to this theory.¹⁵ Truth and fiction or, perhaps better, relationships that have been retained within science and others that have disappeared from this structure appear here visibly side by side. The duct labeled S, "through which the woman becomes impregnated by the seed ejaculated at the time of intercourse," is typical, and it is indispensable to this theory of analogy. Although unknown in modern anatomy, it is pictured in early anatomical descriptions in a style appropriate to that theory—right amidst other excellent data of observation.

When I selected this illustration for the present work, I was tempted to add a "correct" and "faithful" one for comparison. Leafing through modern anatomical atlases and gynecological textbooks, I found many good illustrations but not a single natural one. All had been touched up in appearance, and were schematically, almost symbolically, true to theory but not to nature. I found one particular photograph in a textbook on dissecting techniques. This, too, was tailored to theory with orientation lines and indicating arrows added to make it graphically suitable for use in teach-

*This free, anachronistic translation of *Wunschtraumerfüllung* echoes the title of a paper by Robert K. Merton, "The Self-Fulfilling Prophecy," *Antioch Review*, summer 1948 (reprinted as chap. 13 of Merton's *Social Theory and Social Structure*, New York, 1968).—Eds.

the most absurd assertions. Such contact was generally very tenuous. It was much less the autopsy itself than the ancient views that were consulted, yet this only served to reinforce the ancient thought style. Stereotyped opinions handed down a thousand times meant more to and were considered safer by those authors than any autopsy as such, which was only a "gruesome duty."¹⁷

This period was associated with a specifically symbolic "anatomia imaginabilis" and was followed by another period when a purely morphological approach to anatomy was attempted. The latter, however, could not be pursued without phylogenetic, ontogenetic, and comparative symbols.¹⁸ Then came physiological anatomists, using physiological symbols and evolving chemical organs, the endocrine system, the reticulo-endothelial system: structures to which no sharply outlined morphological organs correspond. During each period with its own characteristic style the concepts used were absolutely clear, since clarity is based upon reducibility to other stylized concepts. Despite this clarity, direct communication between the adherents of different thought styles is impossible.¹⁹ How is the ancient anatomical term "bosom" [*Schoss*],* for instance, to be translated into a modern one? Where is this mystical organ to be positioned?

An example of a nineteenth-century scientific illustration might be added, very similar to the one from the seventeenth century. When Haeckel, the romantic, high-spirited champion of truth, wanted to demonstrate his ideas about descent, he did not shrink from occasionally using the same blocks for the illustration of different objects such as animal and human embryos which should look alike according to his theory. His *History of Natural Creation* abounds with biased illustrations appropriate for his theory. Compare, for instance, the intelligent faces of the old chimpanzee and the old gorilla on figure 13 with the exaggeratedly gruesome ones of the Australian aborigine and the Papuan on figure 14. I should like to mention in conclusion a particularly gross example of the tendency to save a point of view. "The seemingly best support for the heredity of acquired characteristics comes from the experiments of

*The German word *Schoss* means "lap" physically but "bosom" metaphorically or mystically, as to be "safe in the bosom of Abraham."—Eds.

Kammerer. Using the effect of dampness, yellow background, and other, general factors he had altered specimens of spotted salamanders, *Salamandra maculosa*, to appear as striped ones. He excised the ovaries of these artificially striped salamanders, transplanting in their place ovaries of spotted specimens. When he mated these animals with normally spotted salamanders, the latter produced offspring with spots arranged in rows. It appeared here that the artificially altered somatic cells had influenced the egg cells of the mate." These results caused lively discussion until suddenly "Kammerer's experiments were proved to have been fraudulent (1926), a discovery which led to his suicide."²⁰

To the objection that such examples, particularly the last one, are not representative of the normal function of cognition, I would admit that many of these self-fulfilling expectations could be viewed in this way. But as a physician I know that we cannot distinguish sharply between normality and abnormality. The abnormal is often only an enhancement of the normal. It is also known that both normality and abnormality often have identical social effects. Although the philosophy of Nietzsche has, for instance, a psychopathological motif, it generates social effects no different from those produced by a normally conditioned outlook on life. At any rate, once a statement is published it constitutes part of the social forces which form concepts and create habits of thought. Together with all other statements it determines "what cannot be thought in any other way." Even if a particular statement is contested, we grow up with its uncertainty which, circulating in society, reinforces its social effect.²¹ It becomes a self-evident reality which, in turn, conditions our further acts of cognition. There emerges a closed, harmonious system within which the logical origin of individual elements can no longer be traced.

Every pronouncement leaves behind either the solution or the problem, if only the problem of the problem's own rationality. The formulation of a problem already contains half its solution. Any future examination must return along existing thought tracks. The future will never be completely isolated from the past, whether normal or abnormal, except when a break with it occurs as the result of the rules characteristic of the thought structure in question.

The tenacity of systems of opinion shows us that, to some extent, they must be regarded as units, as independent, style-permeated structures. They are not mere aggregates of partial propositions but as harmonious holistic units exhibit those particular stylistic properties which determine and condition every single function of cognition.

The self-contained nature of the system as well as the interaction between what is already known, what remains to be learned, and those who are to apprehend it, go to ensure harmony within the system. But at the same time they also preserve the harmony of illusions, which is quite secure within the confines of a given thought style.

4. Introduction to Thought Collectives

In comparative epistemology, cognition must not be construed as only a dual relationship between the knowing subject and the object to be known. The existing fund of knowledge must be a third partner in this relation as a basic factor of all new knowledge. It would otherwise remain beyond our understanding how a closed and style-permeated system of opinions could arise, and why we find, in the past, rudiments of current knowledge which at the time could not be legitimized by any "objective" reasons and which remained only pre-ideas.

Such historical and stylized relations within knowledge show that an interaction exists between that which is known and the act of cognition. What is already known influences the particular method of cognition; and cognition, in turn, enlarges, renews, and gives fresh meaning to what is already known.

Cognition is therefore not an individual process of any theoretical "particular consciousness." Rather it is the result of a social activity, since the existing stock of knowledge exceeds the range available to any one individual.

The statement, "Someone recognizes something," whether it be a relation, a fact, or an object, is therefore incomplete. It is no more meaningful as it stands than the statements, "This book is larger," or "Town A is situated to the left of town B." Something is still missing, namely the addition, "than that book," to the second statement, and either, "to someone standing on the road between

towns A and B while facing north," or "to someone walking on the road from town C to town B," to the third statement. The relative terms "larger" and "left" acquire a definite meaning only in conjunction with their appropriate components.

Analogously, the statement, "Someone recognizes something," demands some such supplement as, "on the basis of a certain fund of knowledge," or, better, "as a member of a certain cultural environment," and, best, "in a particular thought style, in a particular thought collective."

If we define "thought collective" as a *community of persons mutually exchanging ideas or maintaining intellectual interaction, we will find by implication that it also provides the special "carrier" for the historical development of any field of thought, as well as for the given stock of knowledge and level of culture. This we have designated thought style.* The thought collective thus supplies the missing component.

The statement, "Schaudinn discerned *Spirochaeta pallida* as the causative agent of syphilis," is equivocal as it stands, because "syphilis as such" does not exist. There was only the then-current concept available on the basis of which Schaudinn's contribution occurred, an event that only developed this concept further. Torn from this context, "syphilis" has no specific meaning, and "discerned" by itself is no more explicit than "larger" and "left" in the examples above.

Siegel also recognized, in his own way, protozoa-like structures as the causative agent of syphilis. If his findings had had the appropriate influence and received a proper measure of publicity throughout the thought collective, the concept of syphilis would be different today. Some syphilis cases according to present-day nomenclature would then perhaps be regarded as related to variola and other diseases caused by inclusion bodies. Some other cases would be considered indicative of a constitutional disease in the strict sense of the term. Following the train of thought characterized by the "carnal scourge" idea, still another, completely different set of concepts concerning infectious disease and disease entities would have arisen. Ultimately we would still have reached a harmonious system of knowledge even along this line, but it would differ radically from the current one.

Although such a possibility could be envisioned logically and

"objectively," it can never be construed as a historical possibility. By Siegel's time, the syphilis concept had already become too rigid for such a sweeping change. A century earlier, when the concept was still sufficiently adaptable, the intellectual and experimental requirements did not yet exist for Siegel's finding. We need have no scruples about declaring that the finding of Schaudinn was correct and that of Siegel incorrect. Schaudinn's was uniquely linked with a thought collective (usually there is only one such possible link), whereas Siegel's lacked such a connection. The former served as the junction for lines of development of several ideas within this collective, but the latter did not. The meaning and the truth value of Schaudinn's finding is therefore a function of the community of those who, maintaining intellectual interaction on the basis of a shared intellectual past, made his achievement possible and accepted it.

Correctly formulated, the statement describing Schaudinn's discovery would read as follows: "Conforming to then-current views about syphilis and causative agents, Schaudinn suggested that *Spirochaeta pallida* should be recognized as the causative agent of syphilis. The significance of *Spirochaeta pallida* was duly accepted, and this idea was used for the further development of syphilology." Does not every reputable textbook in bacteriology describe the circumstances in this manner?

Cognition therefore means, primarily, to ascertain those results which must follow, given certain preconditions. The preconditions correspond to active linkages and constitute that portion of cognition belonging to the collective. The constrained results correspond to passive linkages and constitute that which is experienced as objective reality. The act of ascertaining is the contribution of the individual.

The three factors involved in cognition—the individual, the collective, and objective reality (that which is to be known)—do not signify metaphysical entities; they too can be investigated, for they have further relations with respect to one another.

These further relations consist in the facts that, on the one hand, the collective is composed of individuals and that, on the other, objective reality can be resolved into historical sequences of ideas belonging to the collective. It is therefore possible from the view-

point of comparative epistemology to eliminate one or perhaps even two factors.

Although the thought collective consists of individuals, it is not simply the aggregate sum of them. The individual within the collective is never, or hardly ever, conscious of the prevailing thought style, which almost always exerts an absolutely compulsive force upon his thinking and with which it is not possible to be at variance.

The presence of thought style makes it necessary and, indeed, indispensable to construct the concept "thought collective." Whoever might nevertheless prefer to eliminate the thought collective must introduce value judgments or dogmatic faith into the theory of knowledge. In so doing he would only succeed in creating a particular dogmatic type of epistemology out of the general comparative type.

The important role of the collective effort in any scientific work is clearly shown by the history of syphilology as described in chapter 1. Every theme in the sequence of ideas originates from notions belonging to the collective. Disease as a punishment for fornication is the collective notion of a society that is religious. Disease caused by the influence of the stars is a view characteristic of the astrological fraternity. Speculations of medical practitioners about therapy with metals spawned the mercury idea. The blood idea was derived by medical theoreticians from the vox populi, "Blood is a humor with distinctive virtues."* The idea of the causative agent can be traced through the modern etiological stage as far back as the collective notion of a disease demon.

Not only the principal ideas but also all the formative stages of the syphilis concept, however, are the result of collective, not individual effort. Although we spoke of Schaudinn as the discoverer, he really no more than personified the excellent team of health officials whose work, described in the previous chapter, cannot easily be dissected for individual attribution. As we shall presently show, even the origin of the Wassermann reaction is due to a kind of experience of the collective, which actually militated

*Cf. Goethe's *Faust*, line 1740: "Blut ist ein ganz besondrer Saft."—Eds.

against Wassermann's views. Wassermann, like Schaudinn, is rather a standard-bearer in discovery than its sole agent.

When we look at the formal aspect of scientific activities, we cannot fail to recognize their social structure. We see organized effort of the collective involving a division of labor, cooperation, preparatory work, technical assistance, mutual exchange of ideas, and controversy. Many publications bear the names of collaborating authors. Scientific papers almost invariably indicate both the establishment and its director by name. There are groups and a hierarchy within the scientific community: followers and antagonists, societies and congresses, periodicals, and arrangements for exchange. A well-organized collective harbors a quantity of knowledge far exceeding the capacity of any one individual.

The same pertains also to the humanities, although here the organization is less developed. Any kind of learning is connected with some tradition and society, and words and customs already suffice to form a collective bond.

Cognition is the most socially-conditioned activity of man, and knowledge is the paramount social creation [*Gebilde*]. The very structure of language presents a compelling philosophy characteristic of that community, and even a single word can represent a complex theory. To whom do these philosophies and theories belong?

Thoughts pass from one individual to another, each time a little transformed, for each individual can attach to them somewhat different associations. Strictly speaking, the receiver never understands the thought exactly in the way that the transmitter intended it to be understood. After a series of such encounters, practically nothing is left of the original content. Whose thought is it that continues to circulate? It is one that obviously belongs not to any single individual but to the collective. Whether an individual construes it as truth or error, understands it correctly or not, a set of findings meanders throughout the community, becoming polished, transformed, reinforced, or attenuated, while influencing other findings, concept formation, opinions, and habits of thought. After making several rounds within the community, a finding often returns considerably changed to its originator, who reconsiders it himself in quite a different light. He either does not recognize it as

his own or believes, and this happens quite often, to have originally seen it in its present form.* The history of the Wassermann reaction will afford us the opportunity to describe such meanderings in the particular case of a completely "empirical" finding.

This social character inherent in the very nature of scientific activity is not without its substantive consequences. Words which formerly were simple terms become slogans; sentences which once were simple statements become calls to battle. This completely alters their socio-cognitive value. They no longer influence the mind through their logical meaning—indeed, they often act against it—but rather they acquire a magical power and exert a mental influence simply by being used. As an example, one might consider the effect of terms such as "materialism" or "atheism," which in some countries at once discredit their proponents but in others function as essential passwords for acceptability. This magical power of slogans, with "vitalism" in biology, "specificity" in immunology, and "bacterial transformation" in bacteriology, clearly extends to the very depth of specialist research. Whenever such a term is found in a scientific text, it is not examined logically, but immediately makes either enemies or friends.

New themes such as propaganda, imitation, authority, rivalry, solidarity, enmity, and friendship begin to appear—themes which could not have been produced by the isolated thought of any individual. Every such motif acquires epistemological importance, because the entire fund of knowledge as well as the intellectual interaction within the collective take part in every single act of cognition, which is indeed fundamentally impossible without them. Every epistemological theory is trivial that does not take this sociological dependence of all cognition into account in a fundamental and detailed manner. But those who consider social dependence a necessary evil and an unfortunate human inadequacy which ought to be overcome fail to realize that without social conditioning no cognition is even possible. Indeed, the very word "cognition" acquires meaning only in connection with a thought collective.

A kind of superstitious fear prevents us from attributing that

*Cf. the discussion of "the retroactive effect" in R. K. Merton, *Social Theory and Social Structure* (1968), pp. 16, 17, 37.—Eds.

which is the most intimate part of human personality, namely the thought process, also to a collective.²² A thought collective exists wherever two or more people are actually exchanging thoughts. He is a poor observer who does not notice that a stimulating conversation between two persons soon creates a condition in which each utters thoughts he would not have been able to produce either by himself or in different company. A special mood arises, which would not otherwise affect either partner of the conversation but almost always returns whenever these persons meet again. Prolonged duration of this state produces, from common understanding and mutual misunderstanding, a thought structure [*Denkgebilde*]* that belongs to neither of them alone but nevertheless is not at all without meaning. Who is its carrier and who its originator? It is neither more nor less than the small collective of two persons. If a third person joins in, a new collective arises. The previous mood will dissolve and with it the special creative force of the former small collective.

We could agree with anybody who calls the thought collective fictitious and the personification of a common result produced by interaction. But what is any personality if not the personification of many different momentary personalities and their common psychological Gestalt? A thought collective, by analogy, is composed of different individuals and also has its special rules of behavior and its special psychological form. As an entity it is even more stable and consistent than the so-called individual, who always consists of contradictory drives.

The individual life of the human spirit contains incongruent elements, such as tenets of faith and superstition which, stemming from various individual complexes, muddy the purity of any theory or system. Both Kepler and Newton, who contributed so much to the modern concept of nature, were ritualistic and religious in their basic attitudes. Rousseau's ideas of education had much greater

*Fleck's terminology appears ambiguous, for *Denkgebilde* can designate the structures of thought taken as thought products, mental creations, works of the (communal) mind, etc., but it can also be a synonym for *Denkstruktur* taken as mental structures, thought structures, thought patterns, thought forms, etc. In contexts such as this, both may even be intended in the sense of thought structures created according to thought structures.—Eds.

relevance to the thought collective than to his own individual life.

Every individual belongs to several thought collectives at once. As a research worker he is part of that community with which he works. He may give rise to ideas and developments, often unconsciously, which soon become independent and frequently turn against their originator. As a member of a political party, a social class, a nation, or even a race, he belongs to other collectives. If he should chance to enter some other society, he soon becomes one of its members and obeys its rules. The individual can be examined from the viewpoint of a collective just as well as, conversely, the collective can be considered from that of the individual. Whether in the case of the individual personality or in that of the collective entity, that which specifies the one or the other is accessible only to adequate methods.

The history of science also records cases of independent—one might say personal—exploits. But their independence is only characterized by an absence of collaborators and helpers, or possibly of pioneers; that is, it manifests itself in the personal and independent concentration of historical and contemporary collective influence. In a manner corresponding closely to personal exploits in other areas of society, such scientific exploits can prevail only if they have a seminal effect by being performed at a time when the social conditions are right. The achievement of Vesalius as the originator of modern anatomy was just such an audacious and artistic feat. Had Vesalius lived in the twelfth or thirteenth century he would have made no impact. It is just as difficult to imagine him in that era, as it is, for instance, to imagine Napoleon before the French Revolution. Outside the appropriate social conditions, any development into historical greatness would have been denied to both. The futility of work that is isolated from the spirit of the age is shown strikingly in the case of that great herald of excellent ideas Leonardo da Vinci, who nevertheless left no positive scientific achievement behind.

This by no means implies that the individual must be ruled out as an epistemological factor. His sensory physiology and psychology are certainly very important. But a firm foundation for epistemology cannot be established without investigation of the thought community [*Denkgemeinschaft*]. Let me introduce a somewhat

trivial analogy. If the individual may be compared to a soccer player and the thought collective to the soccer team trained for cooperation, then cognition would be the progress of the game. Can an adequate report of this progress be made by examining the individual kicks one by one? The whole game would lose its meaning completely.

The importance of sociological methods in the investigation of intellectual activities was already recognized by Auguste Comte. Recently it was stressed by Durkheim's school in France and by the philosopher Wilhelm Jerusalem among others in Vienna.

Durkheim speaks expressly of the force exerted on the individual by social structures both as objective specific facts and as controlled behavior. He also mentions the superindividual and objective character of ideas belonging to the collective. He describes that which is produced by the activities of the collective intellect, "as we encounter them in language, in religious and magic beliefs, in the existence of invisible powers, and in the innumerable spirits and demons which dominate the entire course of nature and the life of the tribe, and as we meet them in customs and habits."²³

Lévy-Bruhl, a student of Durkheim, writes: "Ideas belonging to the collective follow laws of their own which, especially in primitive races, we cannot discover by studying the white, adult, and civilized individual. On the contrary, it is the study of those ideas belonging to the collective and their connections in primitive societies that throws some light on the origin of our own categories and logical principles."²⁴ "This approach will certainly lead to a new and positive epistemology based upon the comparative method."²⁵ Lévy-Bruhl contests the belief in "the identity of the human mind," "which at all times and in all places is supposed to have remained unchanged as far as logic is concerned."²⁶ He doubts whether "scientific use can at all be made of the idea of a human mind assumed to be untouched by any experience,"²⁷ because this concept "is just as chimerical as that of man before society."²⁸

Gumplowicz expressed himself very poignantly on the importance of the collective. "The greatest error of individualistic psychology is the assumption that a *person* thinks. This leads to a continual search for the source of thought within the individual himself and for the reasons why he thinks in a particular way and not in any other. Theologians and philosophers contemplate this

problem, even offer advice on how one ought to think. But this is a chain of errors. What actually thinks within a person is not the individual himself but his social community. The source of his thinking is not within himself but is to be found in his social environment and in the very social atmosphere he 'breathes.' His mind is structured, and necessarily so, under the influence of this ever-present social environment, and *he cannot think in any other way.*"²⁹

Jerusalem dealt with this problem in a number of essays, the last of them bearing the apposite title "Social Conditioning of Thinking and of Thought Patterns." "Kant's firm belief in a timeless, completely immutable logical structure of our reason, a belief that has since become the common heritage of all who adopt an a priori point of view and is maintained with great tenacity also by the latest representatives of this direction of thinking, has not only failed to be confirmed by the results of modern ethnology but proved to be definitely erroneous."³⁰ "The primitive individual feels himself only a member of his tribe and clings to its traditional way of interpreting sensory perceptions with absolutely incredible tenacity."³¹ "I have no doubt, and it is confirmed though the diverse institutions found in primitive societies, that tribesmen reinforce each other's belief in the ubiquity of spirits and demons, which is already sufficient to give these figments of the imagination some degree of reality and stability. This process of mutual corroboration is by no means confined exclusively to primitive societies. It is rather prevalent today, fully effective in our everyday lives. I wish to designate this process and any structure of belief formed and fortified by it *social consolidation.*"³² "Even particular and objective observations . . . require confirmation by the observation of others. Only then will they become common property and thus suitable for practical utilization. Social consolidation functions actively even in science. This is seen particularly clearly in the resistance which as a rule is encountered by new directions of thought."³³

All these thinkers trained in sociology and classics, however, no matter how productive their ideas, commit a characteristic error. They exhibit an excessive respect, bordering on pious reverence, for scientific facts.

"When mystical elements lose some of their dominance," writes

Lévy-Bruhl, "objective properties ipso facto attract and retain more attention. The share of perception proper grows in inverse proportion to the withering away of mystical ideas belonging to the collective."³⁴

Lévy-Bruhl believes that scientific thought yields concepts which "solely express objective features and conditions of beings and phenomena."³⁵ But he would find it difficult to define the meaning of "objective features" and "perception proper." Moreover, the attraction of attention by objective properties alleged to occur "ipso facto" is psychologically impossible. The perception of scientifically accepted properties (assuming Lévy-Bruhl considers these "objective") must first be learned. It does not occur ipso facto and, indeed, the ability to perceive scientifically is only slowly acquired and learned. Its prime manifestation is discovery. This occurs in a complex, socially conditioned way, which resembles the origin of other ideas of the collective.

"Once the mentality of primitive societies is opened to experience," Lévy-Bruhl continues, "it also becomes more sensitive to contradiction."³⁶ "As soon as any society's intellectual structure and institutions develop, . . . a feeling for, or knowledge of, what physically is possible or impossible emerges and gradually becomes established. The situation is therefore much the same with physical absurdity as it is with logic. The same causes render the prelogical mentality insensitive to both types of absurdity."³⁷

We must object in principle that nobody has either a feeling for, or knowledge of, what physically is possible or impossible. What we feel to be an impossibility is actually mere incongruence with our habitual thought style. Until recently the transmutation of elements as well as many other phenomena of modern physics, let alone the wave theory of matter, were regarded as absolutely "impossible." "Experience as such," to which one has or does not have access is chimerical, and thus every being gains experience according to his own fashion. Present experiences are linked with past ones, thereby changing the conditions of future ones. So every being gains "experience" in the sense that he adjusts his way of reacting during his lifetime. Scientific experience in particular derives from special conditions established by the history of ideas and by society. Traditional patterns of training are involved in this experience, which is, however, not accessible to everyone.

Jerusalem, too, believes in the possibility of "thinking purely theoretically" and "stating given facts purely objectively." "Man acquires this ability only slowly and by degrees, to the extent that by conscious effort he overcomes the state of complete social bondage and thus develops into an *independent* and *self-reliant* personality."³⁸ "Only the strengthened individual acquires the ability to state facts purely objectively and thus learns to think theoretically, that is, free from emotion."³⁹ Jerusalem calls it the "connection between fact and individual." But how is this to be brought into agreement with his statement previously quoted, about the importance of social consolidation even in science?

"A judgment is now objectively true only when it can be considered as exclusively as possible a *function of the process of judgment*. This new, purely objective criterion of truth, which hitherto in a rather superficial and useless formulation was usually designated "agreement" between judgment and facts, must thus be regarded as a product of the tendency to individualistic development."⁴⁰

To this we must object that any thinking, to be emotionless, must be independent of momentary and personal mood, and flow from the average mood of the collective. The concept of absolutely emotionless thinking is meaningless. There is no emotionless state as such nor pure rationality as such. How could these states be established? There is only agreement or difference between feelings, and the uniform agreement in the emotions of a society is, in its context, called freedom from emotions. This permits a type of thinking that is formal and schematic, and that can be couched in words and sentences and hence communicated without major deformation. The power of establishing independent existences is conceded to it emotively. Such thinking is called rational. The causality relation, for instance, was long regarded as purely rational, yet it was actually a relic of strongly emotive demonological ideas belonging to the collective.⁴¹

If we attempt a critical separation of the so-called subjective from the so-called objective in concrete terms, we will find again and again the active and passive links within knowledge that were mentioned earlier. Not a single statement can be formulated from passive links alone. Active links, usually inappropriately called "subjective," are always involved. A passive linkage can be con-

sidered active from a different point of view, and vice versa, as will be discussed in due course. What is the reason for this special position of current scientific statements as required by the philosophers just quoted?

They believe that our present-day scientific opinions are in complete contrast with all other ways of thinking. As if we had become wise and our eyes had been opened, they believe that we have simply discarded the naive self-consciousness of thought processes which are primitive or archaic. We are supposedly in possession of "correct thinking" and "correct observation," and therefore what we declare to be true *is ipso facto true*. What those others such as the primitives, the old people, the mentally ill, or the children declare to be true *seems to be true only to them*. This arch-naïve view, which prevents the building up of a scientific epistemology, reminds us very much of the theory of a French philologist of the eighteenth century who claimed that *pain*, *sitos*, *bread*, *Brot*, *panis* were arbitrary, different descriptions of the same thing. The difference between French and other languages, according to this theory, consisted in the fact that what is called bread in French really was bread.

Natural scientists in their philosophizing commit the opposite and also very typical error. They are aware that there are no "solely objective features and conditions" but only relations governed by a more or less arbitrary reference system. Their error consists in an excessive respect for logic and in regarding logical conclusions with a kind of pious reverence.

To these epistemologists trained in the natural sciences, for instance, the so-called Vienna Circle including Schlick, Carnap, and others, human thinking—construed as an ideal, or thinking as it should be—is something fixed and absolute. An empirical fact, on the other hand, is relative. Conversely, the philosophers previously mentioned with a background in the humanities construe facts as something fixed and human thought as relative. It is characteristic that both parties relegate that which is fixed to the region with which they are unfamiliar.

Would it not be possible to manage entirely without something fixed? Both thinking and facts are changeable, if only because changes in thinking manifest themselves in changed facts. Con-

versely, fundamentally new facts can be discovered only through new thinking. These points will be taken up later.

The fruitfulness of the thought collective theory is revealed especially in the facility with which it enables us to compare primitive, archaic, naïve, and psychotic types of thinking and to investigate them uniformly. It can also be applied to the thinking of a whole nation, a class or any group no matter how it is constituted. I consider the postulate "to maximize experience" the supreme law of scientific thinking. Thus, once the possibility of such comparative epistemology arises, it becomes a duty to carry it out. The old point of view, which is confined to normative pronouncements about "bad" and "good" thinking, is accordingly obsolete.

The views outlined here should not be construed as skepticism. We are certainly capable of knowing a great deal. If we cannot know "everything," according to the traditional position, it is simply because we cannot do much with the term "everything," for every new finding raises at least *one* new problem: namely an investigation of what has just been found. The number of problems to be solved thus becomes infinite and the term "everything" meaningless.

An "ultimate" or set of fundamental first principles from which such findings could be logically constructed is just as nonexistent as this "everything." Knowledge, after all, does not repose upon some substratum. Only through continual movement and interaction can that drive be maintained which yields ideas and truths.