Jack Barbalet

Introduction.

Consciousness is rather like time, as Augustine described it: You know what it is until you try to explain it. The ease of intuitive grasp of consciousness, coupled with the difficulty of intelligible exposition, offer clues to its nature. Because it is a necessary aspect of experience, we correctly feel that we know what consciousness is. At the same time, we struggle to articulate what is meant by consciousness because it is not external to our mental processes, but is a part of them. Consciousness, then, is not readily conceived as an object, in that sense, which would facilitate intellectual apprehension of it. Also, the mental processes in question are inherently complex and, possibly as a result of this complexity, paradoxically, are not adequately captured by self-awareness. With regard to the complexity of consciousness, William James, for instance, remarked that a purely cognitive description of it would leave consciousness dry and without purpose, a situation corrected by appreciating the importance of emotion to consciousness (James 1890a: 141-2). Even more counter-intuitive, it can be fairly asked whether persons are necessarily aware of their consciousness, are they necessarily conscious of being conscious? These are the focal questions – the consciousness of things emotions can provide, and the possibility of lack of awareness of such consciousness – when considering the role of emotions in science, which this paper shall address.

Before discussing emotions in science it is appropriate to change key and subject, and briefly consider the science of consciousness. For most of the 20th century suggestion of a science of consciousness would have provoked derision. Psychology studied behaviour not mind, and rejected introspection as a method of inquiry when it was the most accessible means to consciousness. Neurology was simply uninterested in such ethereal and nebulous things as consciousness, which had no meaning for science. Since the 1990s, however, consciousness has been rehabilitated and is not only now respectable for psychologist and neurologist to study, but highly topical for them to do so. This sea change is a result of developments in technologies, especially those that delineate and provide functional imaging of the electrical correlates of neurological activity. Such technologies reveal a correspondence between neural processes and aspects of conscious experience.

The social sciences, with the possible exception of anthropology, have been left out of the current concentration of scientific interest in consciousness. It is ironic that this too is reversal of an earlier trend. In a 26-page review of developments in the scientific study of consciousness, for instance, half a page only discusses “social theories”, and of the 6 items cited in that short space, none is written by a social scientist (Zeman 2001: 1281-2). No doubt the majority of social scientists today share the image presented here, of a lack of interest in consciousness amongst them. And yet Marx’s treatment of class-consciousness, for instance, defined his account of capitalist society; Durkheim’s discussion of collective consciousness similarly captured his approach to social solidarity. The importance of consciousness to the sociology of Weber, Mannheim, Simmel, Cooley and Mead, to name only the most obvious, cannot go unremarked. While the causes of the tendency for sociology’s disengagement from consciousness require careful consideration, reference to its
recent “cultural turn” indicates a shift from a concern with social actor’s apprehension of a world to which they relate, to a concern with a shaping spirit to which subjects without agency yield. In such realignment, consciousness is lost.

A sociological interest in emotions raises questions concerning consciousness. While the issues treated in such an inquiry will not be the same as those promoted by recent neurological and psychological research, drawing on the findings of such research will enrich sociological discussion. The broad concern of the following discussion is the role of emotions in science. This may at first seem remote from a concern with consciousness. Nevertheless, as we shall see, this enquiry unavoidably raises the question of emotional consciousness and aspects of the nature of consciousness itself. From the point of view of prevailing conventions emotions have only a disrupting or distorting role in science. Science practitioners, science educators and philosophers of science have long insisted that science can only proceed when emotion is expelled. But as emotions are pervasive in giving direction to and energizing human activity, it is a fair working hypothesis that some emotions will have a supporting role in science. Indeed, the significance of emotions in motivation to science is frequently acknowledged. Nevertheless, that emotions may have a positive role in core scientific activities is an idea that continues to attract scepticism. One reason for this, it will be argued, is that the emotions involved operate below the threshold of awareness, which is to say that scientists are typically not conscious of the emotions central to their activities. This idea, that emotions may be nonconsciously experienced, also frequently meets resistance and will also be discussed below.

Part 1: Science and emotions.
Science is arguably the defining social institution of western societies, at least since the 17th century. The importance of science is not simply in its direct output of reliable knowledge, or even only in its contribution to technological development and the consequent expansion of economic production. The significance of these aspects of science is enormous, of course. But in addition to the direct yield of science is another element of its significance that makes it a pervasively dominating institution, namely that its form has tended to be replicated by all other social institutions including those associated with cultural production. There are broad imitative tendencies in areas outside of science to adopt its form. Under the aegis of science practically all areas of human endeavour tend to favour analysis rather than synthesis, for example, measurement rather than rule-of-thumb, and validation rather than enchantment. There is additionally a prevalent suspicion of emotion, exemplified in science and sometimes regarded as a leading if not defining feature of it. Any evidence of a recent weakening of the residual cultural suspicion of emotion may be explained in terms of the declining status of science in contemporary western cultures, as much as any other factor.

While not able to pursue all of the above themes in the present paper, the following discussion will focus on the relationship between science and emotion. The supposed antipathy between science and emotion is typically associated with Cartesian origins (Toulmin 1990: 113-5). The 17th century mathematician and philosopher, René Descartes, famously held that mind and body are radically different substances as it is possible, he argued, to doubt the existence of all physical objects, including one’s own body, but impossible to doubt the existence of oneself as a thinking being. Passions, being of the body, are by hypothesis fundamentally distinct from mind. It follows, then, that science as a mental activity can only be disrupted by
influence of the emotions. This extrapolation, that emotions disrupt science, while frequently attributed to Descartes, is not a complete representation of his position, as we shall see below. It is necessary to be clear, in any event, that concern here is the impossibility of emotion in the intrinsic activities of science. Yet this was not the original basis on which science and emotion were held to be opposed.

Passion in the performance of science but not the communication of science.
When the Royal Society was founded in 1662, according to Thomas Sprat’s *History of the Royal Society* (1667), eloquence in language was abolished because it is contrary to reason and abets passion (quoted in Jones 1953: 85). The underlying assumption seems to be that passion or emotions undermine science. Yet this is a curious conclusion to draw because the scientists who constituted the movement of this period, now known as the Scientific Revolution, frequently referred to the emotions they believed were necessary to their scientific activities.

William Harvey, for instance, writing about his research on mammalian hearts and circulation of blood in 1628, refers to emotional turmoil caused by the puzzlement he experienced in distinguishing systole and diastole. He explains how his “mind was therefore greatly unsettled”, and how this emotional discomfort was resolved through experiment and observation, when “I had attained to the truth, that I should extricate myself and escape from this labyrinth” (Harvey 1628: 273). Isaac Newton, writing in 1672, indicates different emotions but imputes similar importance to them when referring to his response to light shone through a prism:

> It was at first a pleasing divertissement to view the vivid and intense colours produced thereby; but after a while applying myself to consider them more circumspectly, I became surprised to see them in an oblong form; which, according to the received laws of refraction, I expected should have been circular … Comparing the length of this coloured spectrum with its breadth, I found it about five times greater, a disproportion so extravagant that it excited me to a more than ordinary curiosity of examining from whence it might proceed (quoted in Daston and Park 2001: 303).

A century after Newton, Joseph Priestly reports his discovery of oxygen, when burning a candle in “air” extracted from mercuric oxide, in terms of the same emotions:

> But what surprised me more than I can well express, was, that a candle burned in this air with a remarkably vigorous flame … but as I had got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air [nitric oxide], and I knew no nitrous acid was used in the preparation of mercurius calcinatus [mercuric oxide], I was utterly at a loss how to account for it (Priestley1776: 142)

After more detailed description of activity and reaction, following this passage, Priestley goes on to say:

> I wish my reader be not quite tired with the frequent repetition of the word surprise, and others of similar import; but I must go on in that style a little longer (Priestley1776: 146).

The appreciation of the importance of emotion to science during this period has been noted by Lorraine Daston and Katherine Park when they wrote that “[m]using admiration, startled wonder, then bustling curiosity – these were the successive moments of seventeenth-century clichés describing how the passions impelled and guided natural philosophical investigations” (Daston and Park 2001: 303). Even Descartes gave a place in science to wonder, which he calls “the first of all the
passions” (Descartes 1649: 358). This is because the only object of wonder is “the knowledge of the thing that we wonder at” (Descartes 1649: 363) and it therefore “disposes us for the acquisition of the sciences” (Descartes 1649: 365). Too much wonder, though, Descartes warns, can lead to pursuit of triviality and therefore in spite of its positive attributes he continues to regard it cautiously (Descartes 1649: 365).

What concerned the Royal Society was not passion in science but the dangers of passion in persuasion, a fear of distortion in scientific communication through emotion in eloquence. The source of this concern was the 17th century revival of classical rhetoric. Rhetoric is the study and discipline of persuasion. Aristotle’s Rhetoric, which established the field, included a consideration of means of persuasion through the structure of argument and forms of speech. It also included a lengthy discussion of the emotions, “the nature and character of each, its origin, and the manner in which it is produced” (Aristotle 330BC: 19). Aristotle wrote extensively on emotions in his Rhetoric because he believed that the success of persuasive efforts depend in part on the emotional dispositions of the audience. During the 16th century in England, however, works on rhetoric largely focussed on linguistic form and neglected the emotions. This was corrected during the 17th century, through a return to the tradition of Aristotle (Sloan 1971: xxxii-xxxvi). This is best exemplified in Thomas Wright, The Passions of the Minde in Generall, a highly influential work of the time which went through 5 editions from 1601, when it was first published, to 1630, when the last edition appeared. If persuasive effort depends on the emotional dispositions of the audience, then the emotional manipulation of the audience became a further tool of persuasion. It was this latter prospect that led the Royal Society to caution concerning the role of emotion in artful persuasion.

Since the 17th century, concern regarding the place of emotions in science has tended to generalize from distortion in science communication to distortion in the practice of science itself. We shall see, though, that within this latter concern are a number of qualifications giving rise to quite different specific appraisals of the relationship between science and emotions. Indeed, the 17th century situation was more complex than described above, for against the Royal Society’s concern with the possibility of distortion of science communications through emotions, and Harvey’s and Newton’s acceptance of emotional guidance in scientific investigation, there is Francis Bacon’s position that:

The human understanding is no dry light, but receives an infusion from the will and affections; whence proceed sciences which may be called “sciences as one would” … Numberless … are the ways, and sometimes imperceptible, in which the affections colour and infect the understanding (Bacon 1620: 267).

Bacon’s statement resonates with the view that became dominant from the late 18th century, namely that for science to precede emotion must be expelled. The convention from the 18th century, captured by the quotation from Bacon above, and frequently summarized as “Cartesian”, holds that as science is to provide knowledge of the world external to the scientific observer, then science must adequately represent that world, and thus it must be independent of the scientific observer. According to this position, then, scientific knowledge is necessarily impersonal. Representation of the impersonality of science is typically achieved by characterizing science in terms of its formal properties, especially those associated with its methods, rather than in terms of its human attributes, including the scientist’s emotions. The exclusion of emotion from science by virtue of its impersonality is in fact compatible with emotions having a role in two aspects of scientific activity,
namely the motivation of the scientist’s investigation and commitment of the scientist to the social institution of science.

Emotion and scientific motivation.
The motivation of scientists, like that of human agents in general, can be characterized emotionally. The emotions that Newton, Harvey, and Priestley refer to, quoted above, are the affective base of their motivation for scientific investigation. The joy of discovery, for instance, is frequently mentioned as a continuing emotional incentive to engage in scientific work: the “joy of discovery is a very real incentive to research, despite the rareness of its realization” (Baker 1942: 17; see also Feuer 1967: 1, 7, 13). Baker, who was a British zoologist, goes on to show that the emotionality of the scientist’s motivation can coexist with the impersonality of science:

It is an error to suppose that the scientist is unemotional, or could succeed if he were. The error has arisen through a misconception. The absolute necessity that a scientist’s findings shall not be changed from objective truth in response to emotional urges of any kind does not result in his becoming a particularly unemotional person: whether a discoverer or anyone else is pleased with a discovery has no effect on its validity (Baker 1942: 17-8).

Writing at the same time as Baker, the American sociologist Robert Merton shifted the focus away from individual motives to institutional control.

The individual or personal motives of scientists are necessarily diverse, as Merton says, and may include, among a host of possibilities, a “passion for knowledge, idle curiosity, altruistic concern with the benefit to humanity” (Merton 1942: 613) and so on. Against these individual or “distinctive motives” Merton posits the “distinctive pattern of institutional control of a wide range of motives which characterize the behaviour of scientists” (Merton 1942: 613). As he indicated in an earlier article, institutional control does not operate to the exclusion of emotions but refers to a sociologically significant emotional attachment to institutional norms: “The institution of science itself involves emotional adherence to certain values” (Merton 1938: 601). Merton makes his point in terms similar to Baker’s on individual motivation:

although it is customary to think of the scientist as a dispassionate, impersonal individual – and this may not be inaccurate as far as his technical activity is concerned – it must be remembered that the scientist … has a large emotional investment in his way of life, defined by the institutional norms that govern his activity (Merton 1938: 596).

Thus emotions can operate at the level of both the scientist’s individual motivation and commitment to institutional norms, without undermining the essential impersonality of what Merton calls the “technical activity” of science.

In these accounts, then, emotions are confined to the motivational framework of science and not its interior. The sustaining institutional controls of science summarized by Merton as the “ethos of science” and represented as four sets of institutional imperatives, namely universalism, communism, disinterestedness, and organized scepticism, are infused with emotion. Indeed, Merton refers to the ethos of science variously as “an emotionally toned complex of rules, prescriptions, mores, beliefs, values and presuppositions” (Merton 1938: 595 note 16), and, with greater succinctness and increased neutrality, as “that affectively toned complex of values and norms” (Merton 1942: 605). In each case, though, the emotional element is pronounced. And yet, the ethos of science is “one limited aspect of science as an institution” namely its “cultural structure”, and must be distinguished from both the
“set of characteristic methods by means of which knowledge is certified … [and the] stock of accumulated knowledge” (Merton 1942: 605). Thus in this representation the interior of science remains free of emotions.

Merton’s account of the norms of science has been frequently challenged (Barnes and Dolby 1970; Kuhn 1977: 330-9). Even more serious, Merton’s norms have been transgressed without undermining the scientific enterprise but with the effect of enhancing it. In a study based on interviews with 42 eminent scientists who worked on the Apollo moon rocks, for instance, it was shown that rather than open-mindedness among scientists it was frequently dogged commitment and “even bias” that proved to be the “strongest sustaining forces both for discovery of scientific ideas and for their subsequent testing” (Mitroff 1974: 73). Such emotional attachment to ideas and assessments idiosyncratically held and possibly contrary to existing evidence contravenes in various ways the entirety of the ethos of science as Merton conceives it. Nevertheless, such commitments proved necessary for the advancement of science in this case, and were elements in the practice of scientific rationality (Mitroff 1974: 249). While this brief account may undermine the Mertonian ethos, it leaves intact Merton’s view that emotions are in the framework of science but not its interior. Commitment and bias are given to the findings of investigation and are not interior to investigation itself.

In a quite different assessment Lorraine Daston (1995) has shown that because of their implicit metaphysical grounding Merton’s norms are unfortunately impervious to historical variation and cultural modification. In place of this rigid ethos of science Daston posits a “moral economy of science” which is “a web of affect saturated values that stand and function in well-defined relationship to one another … a balanced system of emotional forces, with equilibrium points and constraints” (Daston 1995: 4). Through a discussion of the significance of moral economies in the generation and operations of quantification, empiricism, and objectivity, Daston demonstrates the role of the emotions and values of historically situated scientists in the formation of scientific rationality: “By examining in a new light just those ways of knowing once thought to exempt science from the realm of emotions and values, a study of moral economies may illuminate the nature of the rationality that seemed to exclude them” (Daston 1995: 24). While rightly criticising Merton’s insensitivity to developments of custom and practice, Daston fails to go beyond his relegation of emotion to the framework of science and leaves unexplored the emotional components of the practical activities of science.

**Emotions within science.**

Michael Polanyi (1974) presents a very different approach to the role of emotions in science than Merton’s. He says:

> The outbreak of such emotions [as elation] in the course of discovery is well known, but they are not thought to affect the outcome of discovery. Science is regarded as objectively established in spite of its passionate origins … I dissent from that belief … and want to deal explicitly with passions in science … [S]cientific passions are no mere psychological by-product, but have a logical function which contributes an indispensable element to science (Polanyi 1974: 134).

The function of scientific passion, according to Polanyi, “is that of distinguishing between demonstrable facts which are of scientific interest, and those which are not … [and] also as a guide in the assessment of what is of higher and what of lesser interest” (Polanyi 1974: 135). In addition to this selective function Polanyi identifies
two further functions of scientific passion, the heuristic function and the persuasive function. The latter is self-explanatory. The heuristic passion, which Polanyi says is the mainspring of originality, “the force which impels us to abandon an accepted framework of interpretation and commit ourselves, by the closing of a logical gap, to the use of a new framework”, serves as a guide to enquiry as it “links our appreciation of scientific value to a vision of reality” (Polanyi 1974: 159). Whereas Merton excludes emotions from the method and substance of science, Polanyi says that they are indispensable within it.

Polanyi trained as a scientist and was for many years Professor of physical chemistry at the University of Manchester in England. His statement of the importance of scientific passions therefore can be regarded as a conclusion of participant observation. And yet his account deals only with the functional aspects of scientific passions and lacks a description of the particular emotions involved. Indeed, the scientific passions that he refers to have the form and character of postulated entities rather than of empirical phenomena, more like quarks in quantum chromodynamics than DNA in molecular biology. Another scientist, whose writings have also attracted a philosophical and sociological readership, Ludwik Fleck, also advocated the functional importance of emotions for scientific work. Fleck’s discussion complements Polanyi’s and suggests why description of emotions in science may be so difficult.

Fleck insists that “emotionless thinking is meaningless” (Fleck 1935: 49) when arguing against the German sociologist Wilhelm Jerusalem, writing in 1924, that the appropriately trained “individual acquires the ability to state facts purely objectively and thus learns to think theoretically, that is, free from emotion” (quoted in Fleck 1935: 49). In countering the notion that there is thinking free from emotion Fleck argues that emotion is only either noticed or not noticed, and when not noticed it may be thought to be absent:

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 (Fleck 1935: 49).

The society Fleck refers to is the “thought collective” constitutive of a particular scientific community, and the agreement of feelings he postulates derives from the shared “thought style” that characterizes the stock of knowledge and level of culture of a scientific community (Fleck 1935: 39).

According to Fleck, the emotional basis of science is pervasive (see Barbalet 2002: 140-4). He shows that it is in the structure of the thought collective (Fleck 1935: 105-12), in the epistemological modelling of a “discovery” into a “fact” (Fleck 1935: 86, 119, 144), and in the sense of certainty surrounding “factual” knowledge (Fleck 1935: 117, 145) Given that pattern recognition has such a central role in the observations that are at the heart of scientific research (Ziman 1978: 43-53), it is appropriate to focus on the affective dimension of this aspect of Fleck’s account of scientific discovery. It is here that Polanyi’s first function of scientific passion is to be located, that of “distinguishing … facts that are of scientific interest”.

Fleck indicates, firstly, that scientific observation can occur only after a period of scientific training has been undertaken (Fleck 1935: 48). He immediately goes on to say that the role of training is to generate appropriate experience in the trainee. Experience is so important because it is the basis of emotional sensibility, as we shall see. Through possession of appropriate experience the trainee thereby qualifies for
membership in the thought collective. This experience and its consequences therefore provide access to observations consonant with the correlative thought collective: “Direct perception of form requires being experienced in the relevant field of thought … At the same time, of course, we lose the ability to see something that contradicts the form” (Fleck 1935: 92). The epistemological importance of experience referred to here is in the fact that scientific experience or training produces particular expectations and therefore provides an appropriate focus of attention.

Attention is the property of cognition that selects only a portion of the vast range of sensory involvement for conscious awareness. Fleck gives the example of the selection of different bacterial colonies from over a hundred different cultures. The observations are not “pure”, he says, but “anticipate” differences (Fleck 1935: 90). Expectancy or anticipation is an affective element of a number of particular emotions. It is the fundamental emotional basis of all vision and observation. Because they are not given social representation these emotions are not culturally labelled, and are therefore without names. Thus, scientists are seldom conscious of experiencing them, even though they underpin the conscious awareness of pattern recognition that is central to scientific observation.

Given the significance of emotions in Fleck’s characterization of thought collective it is important to appreciate the consistency of his account of thought style. According to Fleck, truth and facts derive their meaning from particular thought styles. A thought style, Fleck says, “consists of a certain mood and of the performance by which it is realized”. He continues by saying that a “mood has two closely connected aspects: readiness both for selective feelings and for correspondingly directed action” (Fleck 1935: 99). As “mood” changes, so does meaning (Fleck 1935: 110). The link indicated here between emotions and meaning has been observed in a number of contexts, including empirical observation and theory formation (see James 1890b: 312-7; 1902: 128-9). Again, while conscious awareness of meaning is taken for granted, the underlying emotional basis is typically not experienced consciously.

To summarize discussion to this point: Fleck demonstrates the functions of emotion in science that Polanyi similarly points to. The emotions involved remain unnamed by the scientists who experience them, and it is highly probable that scientists are not consciously aware of the emotions involved. While the emotions in question are central to selection of the relevant facts connected with scientific pattern recognition and observation in general, and consciousness of those facts, scientists are not conscious of the underlying emotions. Even the more externally apparent Mertonian emotions essential for motivation and the institutional framework of science are frequently not consciously experienced by the scientists subject to them, judging by the continuing denial by numbers of scientists of emotional involvement in scientific activity.

Part 2: Emotions: conscious and unconscious.
The conclusion of the previous section, that key emotions in science are experienced nonconsciously, is unacceptable to a body of literature. Other relevant literatures, though, in different ways, acknowledge the possibility of nonconscious emotional experiences. The present section of the paper will review arguments concerning this aspect of emotions.

Emotions as conscious states.
The question whether emotions can be nonconsciously experienced was asked in a recent state-of-the-art summary of current findings of emotions research (Ekman and
Davidson 1994). A psychologist (Clore 1994) and a neuroscientist (LeDoux 1994) each answered explicitly that it was not possible for emotions to be nonconscious. A third emotions scientist, a psychologist (Zajonc 1994), was less explicit in so far as his answer to the question seemed to move from nonconscious emotion to nonconscious influence on emotion, things which Clore and LeDoux appropriately distinguished. The arguments of Clore and LeDoux are essentially identical.

Clore holds that “while the cognitive processing that causes the emotion is unconscious, the informational and motivational effects of emotion depend on conscious experience in order to capture the attention of the experiencer” (Clore 1994: 285). He goes on to explain that the feeling component of emotion is necessary, and that it is the fact that the emotion is felt that makes it conscious (Clore 1994: 286-7). These same elements of the argument feature in LeDoux’s account: while unconscious processes underlie emotions, emotional feeling – the fact that emotions are “affectively charged” – means that emotions are conscious states (LeDoux 1994: 291). It is almost a matter of definition, then, that emotions are conscious states, and that they cannot, therefore, be experienced nonconsciously.

Against these conclusions an important contribution to the sociology of emotions has demonstrated that certain emotions, at least, can be experienced without being felt. By combining aspects of the work of sociologist Charles Horton Cooley (1922) and psychologist Helen Block Lewis (1971), Thomas Scheff, for instance, has been able to demonstrate that adult humans typically experience pride and shame with “such low-visibility that [they] do not notice it” (Scheff 1988: 399). It is possible to conclude from Scheff’s argument, therefore, that when the feeling component of the emotion is “by-passed” a person may experience shame without being conscious of the emotion.

Scheff argued that it is possible to indicate an incidence of shame, through presentation of behavioural evidence, even though subjects may fail to report experience of shame. He did this by drawing upon Lewis’ analysis of a large number of clinical encounters, which showed that while participants were not conscious of the majority of shame episodes that they experienced, non-verbal or behavioural shame-markers were nevertheless manifest (Scheff 1988: 401). Scheff went on to confirm Lewis’ conclusions through a re-analysis of Solomon Asch’s celebrated conformity experiments. He shows that Asch’s subjects who unreasonably conformed to a group norm did so under the pressure of unacknowledged and unrecognized shame (Scheff 1988: 402-5). In this manner Scheff shows that a key mechanism of social organization, namely conformity, functionally depends on experiences of shame that occur below the threshold of awareness, that is to say, nonconsciously.

Juxtaposing the conclusions of Clore and LeDoux on the one hand and Scheff on the other raises a number of issues, for both sets of conclusions cannot be correct. One question is the significance and role of feelings in emotions and in consciousness. Not all approaches to emotion accept the primacy of feeling in emotional experience that Clore and LeDoux assume. According to one philosophical theory of emotions, cognitivism, individuals subjectively infer their emotions not from the feelings associated with them but through the beliefs inculcated by the emotions. Cognitivism need not be understood to claim that feeling is not necessary to emotion, only that it is not sufficient. The issue here is not the truth or otherwise of cognitivism, but the question of the status of feeling in emotional experience. Scheff, for one, points to conforming behaviour that the subject may subjectively explain in terms of beliefs, without being aware of a feeling of shame. Another question: even if feeling is a sufficient element of emotional experience, does it follow that the feeling must be
experienced consciously? Clore discredits an account that purports to show that fear can be experienced without the feeling component being consciously experienced (Clore 1994: 286-7). This question does not arise for Scheff when he argues that the feeling of an emotion may be “bypassed”. We shall see that it is not unintelligible to hold that feeling might be experienced nonconsciously.

Unconscious emotion.

When consciousness becomes an object of enquiry, the possibility of an alternative state, unconsciousness becomes a matter of interest. To this point of the discussion nonconsciousness rather than unconsciousness has been mentioned because the former term carries less cultural baggage than the latter, as we shall see. We shall also see that under certain interpretations the terms are more or less equivalent, but not under all interpretations. To appreciate just how confusing the matter of unconsciousness is we might consider Clore’s remark, that “in agreement with Freud, I would argue that it is not possible to have an unconscious emotion because emotion involves an experience, and one cannot have an experience that is not experienced” (Clore 1994: 285). This is to ask: is it possible to have an experience that the experiencing agent is not aware of?

Much routine experience, of course, involves activities of which the subject is not necessarily conscious. Indeed, in “habitual action”, as William James observes, “mere sensation is sufficient guide, and the upper regions of brain and mind are set comparatively free” (James 1890a: 115-6). Typical examples of this include the experience of driving a car or locking the front door when leaving the house. These types of experience frequently contain significant unconscious elements in so far as there is a lack of consciousness awareness of key facets of driving and locking the house on the part of those engaged in such experiences. This occurs even though the experience of driving involves tactile and practical awareness of the clutch and accelerator, of the road, and so on; just as experience of leaving the house involves experience of the door, the lock and the key. It is simply that those persons having these experiences need not be consciously aware of being aware of the things they engage when they drive or lock the door. In philosophical terminology, there is an absence of second-order awareness even though first-order awareness occurs. Could not emotional experiences conform to this type of possibility?

It is implicit in the position of Clore and LeDoux that emotional experiences are different than non-emotional experiences insofar as emotions are themselves a special type of awareness by virtue of the feeling component. This position invites closer consideration. Emotions provide those experiencing them with awareness of both internal processes of arousal and also external objects. Awareness of internal states and external objects is linked by emotion through formation of intention, which is experienced as an internal disposition but whose object is most frequently located in an external environment or arena. It can be accepted that emotion is registered to the person experiencing it through its affective component or dimension, through the feeling of the emotion. As we shall see below, however, it is possible that the emoting subject may not be aware of being aware of their internal arousal nor of an external body that is the object of their emotion, any more than the driver who is aware of the road is necessarily aware that they are aware of the road. The absence of second-order awareness is the condition of unconsciousness in this sense.

For Freud, however, whom Clore invokes in making his case, unconsciousness is not a lack of consciousness but a mental entity in its own right, parallel to consciousness, and possessing its own separate aspirations and concerns. This
distinction, between unconsciousness as an absence of consciousness, and unconsciousness as a distinct mental entity, is crucial in addressing the question of consciousness. It is not always understood (Griffiths 1997: 151-5). According to Freud, personally painful and otherwise emotionally unacceptable memories and thoughts become integrated into a subject’s unconscious through a process of repression. It is a matter of doctrine for Freud that the associated emotions lose their connection with the repressed material and are not themselves repressed (Zangwill 1987: 277). The entity Freud postulates as the unconscious, and the attendant notion that there are no unconscious emotions, simply offers nothing to an understanding of whether emoting subjects are aware of the emotions they experience.

William James, for instance, was aware of the problem of confusing unconscious as an absence and as a substance. Indeed, he developed a critique of pre-Freudian notions of unconscious substance (James 1890a: 164-76). He did not dismiss the importance of unconsciousness as an absence, however, for he observed the significance of experiences of which the subject is not aware. To describe these latter he explicitly rejected the “adjective ‘unconscious’, being for many of them almost certainly a misnomer”, replacing it with the “vaguer term ‘subconscious’ or ‘subliminal’” (James 1902: 170). What James calls subliminal consciousness might be described, in light of preceding discussion, as first-order conscious, in which there is experiential awareness of objects by virtue of affective relations with them, but without attendant second-order consciousness of subject-awareness of first-order consciousness.

Terminological proliferation is not usually a source of clarity, but James does endeavour to avoid confusion when he distinguishes between “consciousness of the ordinary field” on the one hand, and a “consciousness existing beyond the field, or subliminally” on the other (James 1902: 188). Subliminal consciousness, the discovery of which James says is “the most important step forward that has occurred in psychology” during his lifetime (James 1902: 188), refers to “a set of memories, thoughts, and feelings which are extra-marginal and outside of the primary consciousness altogether, but yet must be classed as conscious facts of some sort, able to reveal their presence by unmistakable signs” (James 1902: 188). The context of this discussion is religious conversion, and James is here concerned with the consequences of “strongly developed” subliminal consciousness of religious innovators (James 1902: James 1902: 189). The general significance of subliminal consciousness, however, is its universality (James 1902: 188). Indeed, experience of subliminal consciousness is held to be a “peculiarity in the constitution of human nature” (James 1902: 188).

The role of this peculiarity, as opposed to its incidence, can be readily demonstrated. To take an instance unconnected with James or religious conversion, the behavioural zoologist Niko Tinbergen, for example, discusses the study of posturing behaviour in the Herring Gull:

In a social species such as the Herring Gull, numerous movements of the individual are “understood” by its companions, who react to them in special ways. Some of these movements and postures are not difficult even for the human observer to appreciate, though the detection of most of them requires careful study. There are a multitude of very slight movements, most, if not all, of them characteristic of a special state of the bird. The student of behaviour is to a high degree dependent on his ability to see and interpret such movements. In the beginning, he will notice them unconsciously. For instance, he will know very well on a particular occasion that a certain gull is alarmed, without
realizing exactly how he knows it. Upon more conscious analysis of his own perception (an important element in behaviour study), he will notice that the alarmed gull has a long neck (Tinbergen 1961: 7).

Here is an account of the progress of scientific knowledge and understanding in terms of a movement from subliminal consciousness to second-order consciousness. The first phase includes perceptual awareness of gull behaviour in the absence of awareness of that concrete perception. This is knowing that the gull is alarmed without knowing how it is known. The second phase includes the observer’s awareness of her perception, awareness of being aware of the extension of the gull’s neck. This account is continuous with the discussion of pattern recognition in the treatment above of Fleck’s contribution to our appreciation of the role of emotions in scientific observation.

Emotion and core consciousness.

What James refers to and Tinbergen describes, modern neuroscience explains. Antonio Damasio, for instance, distinguishes “three stages of processing along a continuum: a state of emotion, which can be triggered and executed nonconsciously; a state of feeling, which can be represented nonconsciously; and a state of feeling made conscious, i.e., known to the organism having both emotion and feeling” (Damasio 2000: 37; emphasis in original). According to Damasio, “feeling is a private, mental experience of an emotion”, whereas emotion is understood as “the collection of responses, many of which are publicly observable” (Damasio 2000: 42). The distinction between feeling and emotion drawn by Damasio is curious insofar as these are not symmetrical elements of a frequently associated couple. More typically emotion is understood to comprise a number of elements or components of which feeling is one, the others being motor expression, motivation and behavioural tendencies, cognitive stimulus processing, and neurophysiological processes (see Scherer 1984). It is possible to say that these components are “indicators” of emotion and that no one of them singly or in combination comprises “the emotion”, which remains a particular type of experience (Leventhal 1984: 271-2). The matter of interest in Damasio’s account, however, is that the feeling state need not be registered consciously for it to be experienced.

Damasio demonstrates his claim with a clinical case study. A patient in Damasio’s neurological clinic had 20 years previously suffered extensive damage to both temporal brain lobes that had profound consequences for his capacity to learn and remember. The patient, David, was as a result of his injuries physically incapable of recognizing or naming any of the persons with whom he interacted on a daily basis, and was incapable of ever remembering whether he had seen any of them before. And yet David nevertheless seemed to display consistent preferences and avoidances for certain persons. This apparent inconsistency between David’s condition and his behaviour was examined through an experiment designed by Damasio and a colleague (Damasio 2000: 43-4). The experiment consisted of David being subject to 3 distinct types of interaction over a period of time.

The first type of interaction, with an experimental “good guy”, was pleasant, welcoming and rewarded; the second type, with a “neutral guy”, was emotionally neutral and involved tasks that were neither pleasant nor unpleasant; the third type, with a “bad guy”, was extremely tedious and boring. Subsequent to these encounters David was given 2 further tasks involving photographs of the 3 persons who had played the good, neutral and bad guys. It is important to appreciate that David was able to neither recognize the persons in the photographs nor remember whether he had
ever encountered them before. Nevertheless, when asked to whom he would go if he needed help David consistently chose the good guy and consistently failed to choose the bad guy. Although he was unable to say that he knew anything about the persons in the photographs and could not remember ever seeing them before, when asked who was his friend he consistently chose the good guy (Damasio 2000: 45).

While nothing in David’s consciousness could be responsible for his correct characterization of the good guy and the bad guy, his nonconscious preferences are to be explained in terms of the experimentally induced emotions in the different types of interactions he had been subjected to (Damasio 2000: 45-7). Damasio notes that “David’s brain could generate actions commensurate with the emotional value of the original encounters” (Damasio 2000: 46). It is likely that David’s emotions were accompanied by a feeling of those emotions, but in the “absence of an appropriately related set of images that would explain to him the cause of the reaction” the feelings remained isolated and disconnected from their antecedent conditions and from David’s subsequent behaviour (Damasio 2000: 46). David seemed to have no consciousness of his emotional feelings. Yet David’s emotions provided him with a subliminal consciousness, to revert to James’ terminology, of the good and bad guys. Damasio accounts for the differences indicated here in terms of the distinction between what he calls core consciousness and extended consciousness: David’s core consciousness was intact, but his neurological damage prevented extended consciousness.

Core consciousness, according to Damasio, is essentially a self’s consciousness of immediacy, of the here and now; whereas extended consciousness provides elaboration of each of the component parts of core consciousness to such a degree that it is qualitatively distinct, drawing upon quite different neurological structures and processes (Damasio 2000: 234-76). The sense of self, while rudimentary in core consciousness, is elaborate in terms of identity and personhood in extended consciousness. Extended consciousness goes well beyond the here and now of core consciousness and provides a rich awareness of both a lived past and anticipated future. Extended consciousness but not core consciousness comprises second-order conscious experiences. This is because extended consciousness treats memories and other mental representations as objects, giving rise to a sense of self-knowing. In Damasio’s words: extended consciousness is “the precise consequence of two enabling contributions: First, the ability to learn and thus retain records of myriad experiences … Second, the ability to reactivate those records in such a way that, as objects, they, too, can generate ‘a sense of self knowing’, and thus be known” (Damasio 2000: 197).

It is now possible to state the relationship posited by Damasio, between emotion, feeling, and the two forms of consciousness, core and extended. The relationship between emotions on the one hand and core consciousness on the other is necessary, they occur together or are absent together because they require the same neural substrates (Damasio 2000: 100). There is “no such functional relationship between emotional processing and extended consciousness”, continues Damasio, which is why “impairments of extended consciousness are not accompanied by a breakdown of emotion” (Damasio 2000: 101). Indeed, emotion is part of the mechanism that drives core consciousness. In briefly describing this process, Damasio suggests what is the relationship between feeling and consciousness when he says that:

emotion has a truly dual status in relation to consciousness: the actual responses whose consequences, as an ensemble, eventually produce an
emotion are part of the mechanism that drives core consciousness; a frame of time later, however, the collections of responses which constitute a particular emotion can also be treated as an object to be known. When the “emotional” object is made conscious, it becomes a feeling of emotion (Damasio 2000: 350).

Emotional feeling, then, gives representation to the emotion in thought, introducing a possibility of mental regulation as well as enhanced self-knowledge (Damasio 2000: 56). Emotional feeling, then, is an object of extended consciousness, in which it has instrumental possibilities and through which the emoting subject is aware of it and the emotion with which it is associated. Emotional feeling is a necessary product or consequence of core consciousness, but not known to the emoting subject through it.

Emotional consciousness and consciousness of emotions.
Damasio’s account described above provides a means of overcoming the limitations of those that fail to distinguish between levels of consciousness. It is, however, in many ways similar to an earlier statement in the history of writing about emotion that it nonetheless fails to mention, namely Jean-Paul Sartre’s phenomenological theory of emotion. Damasio’s distinction between emotion as apprehension of the here and now in core consciousness, on the one hand, and the apprehension of emotional feeling as an object in extended consciousness on the other, has its analogue in Sartre’s earlier statement of a distinction between emotion as a form of consciousness on the one hand, and consciousness of emotion on the other.

Sartre begins by describing emotion, in contradistinction to the usual psychological and psychoanalytic accounts, as an “indispensable structure of consciousness” (Sartre 1939: 15). The consciousness that pertains to emotion, however, is not consciousness of the emotion, but rather the emotion’s consciousness of the world. Sartre says that:

Fear is not originally consciousness of being afraid … Emotional consciousness is, at first, unreflective … Emotional consciousness is, at first, consciousness of the world … the person who is afraid is afraid of something (Sartre 1939: 50-1).

As emotion is necessarily conscious of its object, which is in “the world”, Sartre insists that emotion is therefore never unconscious but only unreflective (Sartre 1939: 56-7). None of this departs from the position that has been developed in preceding sections of this discussion, even though there is a continuing absence of terminological consistency – which reflects the state of the literature and not the present writer – conceptual agreement is nevertheless achieved. Emotion is consciousness but unreflective in the sense that as an apprehension of the world, or at least objects in it, emotion entails first-order consciousness. Sartre insists that second-order consciousness of emotion is not required for emotional experience. This latter, for Sartre, is emotional apprehension of the world rather than the emoting subject’s awareness of those emotions.

Here, then, Sartre’s idea that emotions are never unconscious is merely terminological. An absence of consciousness of emotion is not an instance of nonconscious emotion because emotion itself is a form of consciousness as relating to an object in the world. Incidentally, Sartre also explicitly rejects the notion of unconscious substance, conducted in a slightly earlier work (Sartre 1936-7: 54-8). It is ironic, given his critique of William James’ theory of emotion (Sartre 1939: 22-40), that Sartre’s critique of unconscious substance is reminiscent of James’ argument against unconscious substance, mentioned above.
In all of this Sartre says in a different way what has already been treated in discussion above. The real novelty of Sartre’s account of emotions, however, that for our purposes is especially relevant for an understanding of the role of emotions in science, is his account of the transformative capacity of emotion. But what is of value in this notion has to be surgically extracted from Sartre’s incomplete and misleading treatment of the magical nature of emotional transformation.

Sartre says that emotional consciousness, a consciousness of the world through emotion, is “a certain way of apprehending the world” in which “the affected subject and the affective object are bound in an indissoluble synthesis” (Sartre 1939: 52). The apprehension of the world through emotional consciousness, he goes on to say, is a “transformation of the world” (Sartre 1939: 58). Sartre explains:

When the paths traced out become too difficult, or when there is no path, we can no longer live in so urgent and difficult a world. All the paths are barred. However, we must act … Before anything else [emotional consciousness] is the seizure of new connections and new exigencies … Thus, through a change of intention, as in a change of behaviour, we apprehend a new object, or an old object in a new way … The impossibility of finding a solution to the problem objectively apprehended as a quality of the world serves as motivation for the new unreflective consciousness [emotion] which now perceives the world otherwise and with a new aspect, and which requires a new behaviour – through which this aspect is perceived – and which serves as [material] for the new intention (Sartre: 1939: 58-60).

The characterization of emotional consciousness, as transformation of the world through seizure of new connections and the apprehension of a new object or an old object in a new way, is entirely equivalent to Adam Smith’s (1795) account of scientific discovery in “The History of Astronomy”, to which we shall turn shortly. While Sartre is correct to insist that “emotion is … accompanied by belief [about the world]” (Sartre 1939: 73), his claim that such beliefs are necessarily false cannot be sustained.

Sartre is committed to untruth in emotion. He regards emotions as essentially magical not because he associates emotions with imagination but because he assumes that actors engage emotional consciousness only when they are impotent in facing a world hostile to their desires (Sartre 1939: 67). Even joy is rationalized in this way when Sartre describes its expressions, dancing and singing, as “symbolically approximate behaviour, incantations” designed to “realize the possession of the desired object as instantaneous totality” (Sartre 1939: 69). The characterization of emotion as magical in transforming, indeed distorting, reality in order to match frustrated desire, leads Sartre to describe it as degraded consciousness (Sartre 1939: 75-6, 77, 83). Inherently ineffective, according to this view, emotion is at best a form of coping behaviour, for Sartre. And here is the flaw in Sartre’s otherwise suggestive and potentially useful account of emotion: not all emotions are expressive, nor are they meaningfully describable as behaviour, as Sartre argues (see Solomon 1981: 222). Indeed, the emotions central to science that manifest transformative powers of reconceptualization of natural relationships are not behavioural and entirely nonconscious, or, in Sartre’s terms, unreflective and not the objects themselves of consciousness. Before discussing further the transformative power of emotions, we shall briefly consider their truth value.

In the passage quoted above Sartre refers to the “impossibility of finding a solution to the problem objectively apprehended as a quality of the world [which] serves as motivation for the new unreflective consciousness [emotion] which now
perceives the world otherwise and with a new aspect”. The objective world is somehow unacceptable thus promoting a response that is an emotional apprehension that presents the world differently. There is a double error in Sartre’s statement. First, what might be called an empiricist dogma that objectively ascribed qualities are timelessly true; and second, that emotional consciousness is necessarily false.

Sartre’s archetypical emotional transformation is performed by Aesop’s fox, who in his disappointment and frustration in failing to reach ripe grapes turns them sour (Sartre 1939: 61). This is one possibility, certainly. But it is not the only one. Compare Sigmund Freud’s characteristically similar acknowledgment of the transformative power of emotion, when he refers to love, for example, as leading to “sexual-overestimation”, to “idealization” that “falsifies judgment” (Freud 1921: 190), with James’ treatment of love, in which special qualities of another, otherwise missed without the penetrating cognitive benefit of love, are apprehended through it (James 1899: 266-7). While there is no guarantee of truth in emotional experience, there is no necessity of untruth either. In the context of science, emotion is foundation to advancement of knowledge through its transformative capacity.

In a remarkable but neglected treatment of emotions in science, contemporary with historically early scientific achievement, Adam Smith (1795), in a posthumously published essay, points to a transformative capacity of emotions to which Sartre is blinded through magical incantation. Natural philosophers, says Smith, through training and disposition, are liable to “feel an interval betwixt two objects, which, to more careless observers, seem very strictly conjoined” (Smith 1795: 45). The natural philosopher’s experience of a thing’s “dissimilitude with all the objects he had hitherto observed” has the consequence of producing in him “uncertainty and anxious curiosity” (Smith: 1795: 40). These anxious and painful emotions that beset the scientist or natural philosopher are cured by scientific engagement:

> Philosophy, by representing the invisible chains which bind together all these disjointed objects, endeavours to introduce order into this chaos of jarring and discordant appearances, to allay this tumult of the imagination, and to restore it, when it surveys the great revolutions of the universe, to that tone of tranquillity and composure, which is most agreeable in itself, and most suitable to its nature (Smith 1795: 45-6).

Science, then, relies on an emotional process of the anxious discomfort of perception of disjuncture leading to the construction of explanations – representations of “invisible chains” – that ease the pain, as “the repose and tranquillity of the imagination is the ultimate end of [natural] philosophy”, according to Smith (1795: 61). In Smith’s account, then, a problem objectively apprehended promotes an emotional experience that leads, through the transformative capacity of emotion, to a new perception of objectively ascribed qualities of the world, which can be described as more appropriately, accurately or truthfully representing that world.

Part 3: Self-transcending emotions and science.

**Self-asserting and self-transcending emotions**

Rebuttal, above, of Sartre’s supposition that emotional transformation necessarily leads to false constructions of reality was that such transformations do not necessarily lead to false constructions. An understanding of the role of emotion in science requires more than so ambiguous a conclusion. The transformative capacity of emotions that Sartre focuses upon, and that Adam Smith also points to in his history of the progressive attainment of improved astronomical knowledge, is connected with emotional intentionality. There is broad agreement that emotions are not mere
apprehensions of reality but interested apprehensions that lead those who experience them to particular dispositions.

A defining feature of emotions is that they perceive the world from the perspective of the emoting subject’s needs or preferences. Few would disagree with the statement that:

one of the major functions of emotion consists of the constant evaluation of external and internal stimuli in terms of their relevance for the organism and the preparation of behavioural reactions which may be required as a response to those stimuli (Scherer 1984: 296).

Different evaluations are entailed in different emotions. If the environment is experienced as unduly inhibiting, for instance, the “organism” will evaluate it as hostile and the accompanying emotion will be anger through which there is preparation to act against what is perceived as the constraining factor. Sartre’s insight is to see that a person’s inability to cope with changes in their circumstances may transform a notice from the bank, for instance, into the service manager’s hostility. But this is not the only possibility. It is not the only possibility not just because different people see the world differently but also because there are different types of emotions, and the intentionality of some do not function to assert self-needs in this narrow sense.

When Scherer wrote the passage quoted above it is likely that he had in mind those emotions that are associated with the possibility of behavioural reaction, that typically have high expressivity and clear if not strong physiological correlates, such as anger, fear, love, disgust, shyness and so on. There are a number of ways in which emotions can be categorized; the most frequently cited being the distinction between basic or primary emotions and secondary emotions. The categorization that is most useful in understanding the role of emotions in science, however, is that which distinguishes self-asserting emotions on the one hand and self-transcending emotions on the other. This categorization can be traced back to the work of William James, and no doubt many other writers, and is explicitly stated by Arthur Koestler (1964). The emotions listed above, and that best fit the statement of function in the quotation from Scherer in the previous paragraph, are self-asserting emotions. Self-transcending emotions have a very different profile and serve quite different purposes.

Koestler noted that self-transcending emotions tend to be ignored by emotions researchers, who typically focus instead on self-asserting emotions (Koestler 1964: 285). The neglect of self-transcending emotions, which continues still, is a measure of their lack of salience but cannot be construed as an index of their lack of importance or infrequent incidence. Examples of self-transcending emotions identified by Koestler include grief, longing, worship, raptness, and aesthetic pleasure (Koestler 1964: 285). While all emotions are in principle delinked from action, self-asserting emotions entail characteristic dispositional programs in which the possibility of action consequent upon them is an element in their meaning. Experience of fear, for instance, does not necessarily lead to flight or fight, but the possibility of these associated behaviours is integral to what is meant by fear. A characteristic feature of self-transcending emotions, on the other hand, is the relative absence of behavioural concomitant. As Koestler says, “grief, longing, worship, raptness, aesthetic pleasure are emotions consummated not in overt but in internalized behaviour … [that] induce passive contemplation, silent enjoyment” (Koestler 1964: 285). Here is the lack of salience or visibility in self-transcending emotions. But here also is a property of a type of emotion that would perform service to and is likely to be associated with science.
By its nature, science is a cognitively expansive set of practices, ever seeking new findings and new means for attaining new findings. Indeed, one concern of those fearful of the disruptive role of emotions is the way in which emotions may inappropriately narrow scientific focus through the introduction of self-interested goals. This was the issue mentioned above in Baker’s expression of the concern that “a scientist’s findings shall not be changed from objective truth in response to emotional urges” (Baker 1942 17-8). This possibility is a justifiable concern relating to self-asserting emotions because of their propensity to narrow the consciousness of those who experience them. Self-transcending emotions, on the other hand, partly because they share a participatory dimension, Koestler says, involve “an expansion of consciousness by identificatory processes of various kinds” (Koestler 1964: 286). This point can be demonstrated by considering one particular self-transcending emotion, aesthetic pleasure, and its role in science.

Aesthetic emotion in science.
When a choice has to be made, regarding what particular direction would move scientific research forward, Thomas Kuhn notes that it is not infrequent that sound reasons exist for a number of different options or possibilities (Kuhn 1977: 328). Under such circumstances, closure cannot be achieved by appeal to the facts because alternative possibilities will each typically draw on factual support. Kuhn’s resolution is an appeal to values. This approach, however, must be regarded at least incomplete, for Kuhn says that values “influence” but do not “determine” choice (Kuhn 1977: 331). It should be noted that scientists themselves frequently appeal not to values but to aesthetic pleasure in such circumstances, even though they seldom if ever report such emotions in scientific publications. One reason that aesthetic pleasure as a decision mechanism is not incorporated in research findings is the assumption that such feelings are entirely personal and therefore lack the qualities appropriate to sustain research. Nevertheless, implicit in the notion of a scientific community, for instance, is the possibility that experience of aesthetic pleasure is not merely private and idiosyncratic but rather an outcome of consistency of social milieu. Indeed, the importance of training and experience to scientific cognition, discussed above, further suggests a basis of convergence of aesthetic judgement in scientific communities and its possible application to scientific decision making.

Aesthetic experience has a number of elements, of which the emotional component is the most obvious. A second element, that reinforces the self-transcending nature of aesthetic pleasure, is the intellectual component of aesthetic experience. This aspect is inherent in aesthetic pleasure because such experiences are disinterested in the sense that they arise from focus on an object’s appearance or structure. As a consequence of disinterested concentration the aesthetic object’s instrumental or practical attributes, which relate more directly to the needs of self-assertion, are placed out of focus. In this way the intrinsic properties of objects are emotionally apprehended through aesthetic pleasure (see Maslow quoted in Kemper 1979: 305). This raises, then, the question of the phenomenal object of the emotional-intellectual pleasure that derives from aesthetic experience, to which we now turn.

The aesthetic object is never a thing in itself, but refers instead to an arrangement of things or parts, or to a perspective that permits a view of arrangements. At the heart of aesthetic experience, and the source of joy that accompanies it, is perception of characteristic organization or form in an apparent disconnection or even chaos of parts. Aesthetic experience, then, arises through perception of a particular type of organization of elements that realizes certain values.
To this extent Kuhn is correct to point to the role of values in theory choice. The values integral to aesthetic experience have been identified by Maslow, for instance, as wholeness, uniqueness, and aliveness (quoted in Kemper 1979: 303). Within the context of a scientific community, the appreciation of such values will be inherent in the structure of the thought collective, to use Fleck’s (1935) term, referred to above. Indeed, the experiential basis of scientific cognition, discussed above, necessarily includes a practical specification of precisely those values central to such aesthetic experience.

Aesthetic experience, then, is a response to the realization of the values characterized here as wholeness, uniqueness, and aliveness, in the circumstances of scientific research and decision-making. In other words, aesthetic experience is a response to a correspondence between these values of the scientific thought collective and the conditions encountered in a particular research episode. The attainment of correspondence between values and condition is the circumstance that evokes the emotions of joy, delight, and pleasure. Kuhn’s reference to mere values is therefore insufficient in so far as the efficacy of values in scientific choice is through the role of emotions in signalling correspondence between values and conditions in aesthetic experiences.

The conditions have now been specified in which values can be regarded, as Kuhn suggests, as a guide for action through ambiguous situations. That a scientist realizes her values is a necessarily desirable event, in which satisfaction, indeed joy, is inherent. This is the point: the experience of joy, which is the affective force of all aesthetic experience, is the emotional expression of the realization of values, of attaining a correspondence between the values which guide a scientist’s choice and the conditions that that scientist encounters and perceives. In signalling a perception of correspondence between values and conditions, joy is precipitated as a feeling of self-actualization and meaningfulness in a person’s activities, indeed being (de Rivera 1977: 64). It can be noted, given the role of wonder in scientific discovery, that joy and wonder have been described as parallel emotions (de Rivera 1977: 66).

The aesthetic experience, then, in the context of scientific choice, is an emotional apprehension of one possibility of action or direction over others on the basis of a felt realization of pertinent values in one set of conditions or practices and their absence in alternative conditions or practices. That this is an emotional apprehension of choice reflects the nature of scientific choice. It must be emphasized that these latter arise when “there is always at least some good reasons for each possible choice” (Kuhn 1977: 328). The question of choice arises not because there is an absence of evidence for one finding or theory as against others, but because there is evidence for all, and therefore an absence of determining evidence. The necessity of aesthetic emotion or joy is therefore unavoidable in such circumstances in the development and progress of science. Because the emotions involved are self-transcending they direct first-order consciousness of the objects they apprehend that then becomes the object of second-order consciousness.

Through the emotions within scientific activity the scientist is aware of the objects the emotions bring to consciousness, even though the emotions do not draw attention to themselves. As archetypical self-transcending emotions they are experienced through the aesthetic objects they draw to the scientist’s attention and are themselves experienced nonconsciously. An extremely astute observer, the plant morphologist Agnes Arber, has captured something of this:

It is not possible to offer strict scientific evidence for the idea that not only reason but emotion has a function in biological discovery … we can only point
to slight indications which are at least compatible with its truth. It is recognized, for instance, that the moment at which a fruitful combination of ideas enters the awareness, is often charged with a particular feeling of joy, which precedes and seems independent of, the rational satisfaction of goal-attainment (Arber 1954: 20-1).

The joy that Arber refers to is not the motivational joy exterior to science that comes with the satisfaction of any job well done. It is an emotional basis of activity interior to science. Neither is this joy register of the conclusion of a piece of scientific work, but the affective mechanism that allows it to continue toward its conclusion.

Conclusion
It has been shown that emotions are not only central to the sustaining framework of science but also necessary in its core activities. Emotions are able to discriminate between relevant and irrelevant objects of scientific concern, and underlie the scientist’s consciousness of those objects. That such emotions are typically experienced nonconsciously is a dimension of emotional experience deserving of further investigation. Indeed, it is likely that the incidence of an absence of full conscious awareness of emotional experience is not confined to science, and in the broad span of human activity is statistically very high. Study of science, then, in addition to its intrinsic interest is also in this regard a model for research of other social institutions where nonconscious emotional experience is to be found.

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