

Empirical Grounding of Jungian Psychology: Dreams and the Spencer Social Chemosignals Experiment

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Abstract

In this paper I propose the simple modification of an experiment by Natasha Spencer and colleagues published in a medical journal in 2004. The aim of this modification is to empirically verify a central hypothesis of Jung's that dream content, though culturally and individually inflected, accurately reflects inner changes in the dreamer's life, whether corporeal or psychological. The methodology employed is the shared observation methodology developed by Alan Chalmers, the Australian philosopher of science. Should the modified experiment succeed in empirically confirming the hypothesis, further research would be justified. The benefits would be particularly relevant to medical diagnosis and in developing research paradigms, but it would also be significant culturally and in broader terms.

Keywords

Pheromone, exocrine, sexual motivation/desire, Chalmers, shared observation.

For not in vain and without reason has God bestowed on and given to man in the highest part of his body two eyes and ears in order to indicate that man has to learn and heed within himself a twofold seeing and hearing, an inward and an outward, so that he may judge spiritual things with the inward part and allot spiritual things to the spiritual (I Corinthians 2), but also give the outward its portion.

(Wasserstein der Weysen, German medieval text, 1619)

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Introduction

The standard mainstream academic critique of Jungian psychology is that it has no empirical basis. This perception tends to unduly isolate Jungian thought from mainstream academic culture, to the detriment of both. Although many Jungian writers have noticed this lack of empirical confirmation, as far as I can tell, no experiments have actually been carried out. For instance, in the early 1960s, the English analyst E. A. Bennet, in his correspondence with Jung, expressed the hope that the theory of archetypes one day could be put on an empirical basis (Bennet, 1961).

Naturally, an empirical confirmation only occurs once a suggested experiment is carried out. What follows is nevertheless an experiment design for such an experiment. I propose a simple modification of Natasha Spencer et al.'s (2004) experiment on chemosignals from breastfeeding women in order to empirically confirm Jung's hypothesis that dream content reliably depicts, in symbolic language, the inner state of the dreamer.

The Spencer double-blind controlled experiment showed that fertile nulliparous women's sexual desire was increased by exposure to human exocrine or breastfeeding compound when compared with a control group. Breastfeeding compound was auxiliary and consisted of breast secretions from breastfeeding mothers. The test subjects were twice daily exposed to a placebo for one month in order to establish a baseline of comparison, then twice daily exposed to thawed breastfeeding compound for two months. The control group was exposed to placebo for the entire three months.

In this experiment, sexual desire was measured by a questionnaire. No significant increase was found in the control subjects. However, in the exposed subjects, significant change did occur, manifesting in increased sexual fantasy for those without partners or increased sexual activity for those with a partner during the two months of exposure.

The new experiment I have designed for this article allows a central hypothesis of Jung's to be empirically tested using the Australian philosopher of science Alan Chalmers's shared observation methodology (Chalmers, 1999). Since his research design requires observing the same phenomenon via two different methods of observation, my suggested experiment has two halves. For the first half, I propose using the finding from Spencer et al.'s original experimental design. The second (and new) half of the shared observation methodology is supplied by a modification: to simply ask the subjects to record their dreams in a dream journal throughout the Spencer experiment. The first half offers a method of observation via the conscious mind; the second via the unconscious.

Should the two sets of data—from the conscious mind via Spencer’s questionnaire and from the unconscious from recorded dream contents—repeatably correlate, then this would empirically confirm Jung’s hypothesis that dream content reliably depicts, in symbolic language, the inner state of the dreamer, at least in the context of exposure to human exocrine secretions. This alone would justify further research, and raise the inference that Jung’s hypothesis could be more widely if not generally true. This would immeasurably bridge the gap between Jungian and wider academic scholarship.

Jung’s Central Hypothesis about Dreams

A central hypothesis of Jung’s is that the dream image faithfully reflects the inner state of the dreamer at the time. Accordingly, Jung calls the dream image a “mirror.” He writes:

Whoever looks into “the mirror of the water” will see first of all his own face. Whoever goes to himself risks a confrontation with himself. The mirror does not flatter, it faithfully shows whatever looks into it; namely the face we never show to the world because we cover it with the *persona*, the mask of the actor. But the mirror lies behind the mask and shows the true face. (Jung 1954/1968, para. 43)

The mirror of the water here refers to dreams and their images, that is, the process of looking into one’s own unconscious via dreams. The question arises, though: What in fact is being reflected? Jung’s answer appears to be that dreams reflect the inner reality of the dreamer himself or herself, even though outer references occasionally do occur (Jung, 1948/1969).

For the proposed modification of the Spencer experiment, it is enough to focus on Jung’s proposal that dreams faithfully reflect the present inner reality of the dreamer and that inner reality includes both physiological and psychological changes. Sexual desire may thus manifest in fantasy as well as sexual activity. This perspective is given formal recognition in analytical psychology by assuming that instinct equals archetype and will be considered next.

The Instinct-Archetype Equation

Since sexual desire is biological but also, simultaneously, experienced as numinous, it falls within the scope of the proposal that “instinct equals archetype.” This theory of Jung’s is perhaps expressed most clear-

ly by Edward Edinger. He writes, "All that is called instinct in biological terminology, when experienced psychologically is best described as Deity" (Edinger, 1995b, p. 101).¹

Without placing numinous feelings in a particular religious context, this understanding bridges the span between behavior and experiences. (Whether inner images fall within a given religious tradition or teaching is an entirely separate question.)² The finding in the original Spencer experiment nevertheless appears to support a general hypothesis of "instinct equals archetype." The subjects exposed to breastfeeding compound experienced artificially induced desires that resulted in either increased sexual fantasy for those without partners (at the archetypal pole of the equation) or in increased sexual behavior for those with partners (at the biological pole of the equation).

This raises the larger philosophical question of how these two aspects of the same phenomenon—sexual desire, in this case—relate to each other.³ There is quite a body of anecdotal evidence, from other contexts, of contents in dream and hallucination referring accurately to specifics in outer reality. As I show in Appendix 2, instances from the history of science and mathematics strongly suggest that there has to be some way that a symbolic dream content relates to outer, empirical, everyday reality beyond a simple and thoroughgoing dichotomy.

Fortunately, the current purpose of designing an experiment to test Jung's dream hypothesis does not require an answer to the larger philosophical question of how exactly the two poles of the "instinct equals archetype" equation relate to one another. I am content to leave it for further explorations, the more so because I do not pretend to know exactly how the two sides may be related. That must await further and better research.

Benefits of the Hypothesis Being Confirmed

Nonetheless, Jung's hypothesis would have a lot to offer if it could be empirically confirmed. A successful confirmation would help bridge physiology and dream-oriented psychologies. For example, Anthony Stevens (2002), a British Jungian analyst, comments:

Jungian discourse has become increasingly disembodied, as if the physiological correlates of psychic events were of little or no account. Individuation is conceived to be a wholly spiritual process in which all biological contributions (except the maintenance of life itself) are disregarded as irrelevant. This is in marked contrast to Jung's own

position: "We keep forgetting that we are primates and that we have to make allowances for these primitive layers in our psyche. Individuation is not only an upward, but a downward process. Without any body, there is no mind and therefore no individuation." (p. 55)

Looking at the divide from the other side, from the point of view of the materially and rationally oriented research scientist, Jung has a great deal to contribute to one of the central problems, if not mysteries, in research, which is the crucial question: How to choose the seminal or kick-off question for a new research program? The American philosopher of science Gerald Holton (2005) comments:

There is, however, another ingredient, an additional talent which has, in fact, been decisively important in certain major scientific breakthroughs; *however an embarrassed silence reigns over this additional ingredient in research journals and in the training of future scientists and researchers.* To describe this talent, Hans Christian Oersted used the felicitous phrase "anticipatory harmony with nature"; Arthur Schopenhauer, for his part, recognized the traces of genius in this talent; Einstein spoke of "Fingerspitzengefühl" or the feeling at the tips of one's fingers; and the students and co-workers of Enrico Fermi privately praised his "formidable intuition." To put it baldly, this element, normally not spoken of as part of the scientist's "toolkit," despite its familiarity to historians of science, is the innate intuition of certain scientists. Scientists might well formulate the question as follows: How is one to plan the research project in the first place, what leap of the imagination is one to attempt at the very beginning of one's research? (p. 26, italics added, translation mine)

As noted, a number of examples of impetus for research from dreams are given in Appendix 2. Seen from the Jungian side, there is no reason why this innate intuition cannot be developed deliberately, as part of an individual's scientific or research-oriented education. Both sides of the divide can benefit, I believe, if Jung's hypothesis that "the mirror faithfully reflects" can be empirically, and repeatably, confirmed.

One final benefit of Jung's psychology, one employed by Jung himself, is the use of dreams in diagnostic assessments.⁴ Once again, the "instinct equals archetype" equation undergirds the analysis. Equally, there is no reason why this aspect of analytical psychology could not be

further developed deliberately as a new diagnostic tool and as part of medical education. A rapprochement between Jung's theories and medical science would thereby be cemented.

Methodology

For this rapprochement to occur on an institutional rather than a still praiseworthy individual level, an empirical confirmation of Jung's hypothesis is required. One way of achieving this is with the previously mentioned methodology of Chalmers (1999, pp. 162–170).

Chalmers's shared observation methodology validates a new and so far untried method of observation in terms of an older pre-existing method of observation. It was used by Galileo to validate telescopic data when his contemporary critics believed that telescopic data was illusory. It was also used early in World War II, when radar was being developed, for validating the first uses of radar for terrestrial purposes (Conant, 2002, pp. 171–172, 265). Also, shortly after World War II, it was used to validate celestial radio telescope data. Using radar for space observation was at that time still a new and untested method of observation. Jung's use of dream content to observe the inner state of an individual is in the same untested, and perhaps untrusted, category, when seen from a mainstream scientific perspective.

In shared observation, two sets of data are collected, one from an older, established, and trusted method and another set of data from a yet-untested method of observation. The two sets of data are collected about an object assumed to fall within the overlap of the two methods.

In the case of radio astronomy, for example, the two camps, optical astronomers and radio astronomers, initially mistrusted one another. In 1951 and 1952, Baade and Minkowski, two German optical astronomers, were able to correlate the two methods. Both radio and optical data were correlated for the first time in identifying Cygnus A and Cassiopeia A (Robertson, 1992, p. 52). These stars were already known by means of telescopic astronomy. Strong radio signals were now found from the specific area of the constellations. It was suspected, or hypothesized, but not known with certitude, that the strong radio signals in fact emanated from these constellations. Upon closer scrutiny, the two up-to-this-point formally unrelated sets of data were found to refer to the same stars, and this was the first clue. As stars cannot be moved to verify the data by some type of intervention (pheromones however can!), later observations of other stars then verified the validity of radio data in doubles and triples. Thus, shared observations (i.e., via both methods at once) confirmed the validity of a previously hypothesized situation.

The same shared observation methodology can be used to validate dream data by placing it alongside data already found to be reliable, that is, via questionnaires. The method in Spencer et al.'s original experiment is such a method. If both methods repeatably correlate, this would validate dream contents as valid data for determining a dreamer's inner state in empirical, therefore collectively valid, terms.

The Hypothesis as a Method of Observation

The attentive reader will have noticed that I skipped a step in the argument. What I first treated as merely a hypothesis (Jung's hypothesis that "the mirror faithfully reflects . . . whatever looks into it"), I am now treating as a full-blown method of observation, without a clear justification. However, I skipped this step in order to first make the methodological connection between Chalmers's methodology and the suggested experiment design clear.

The missing step in the argument is supplied by the term "faithfully" in Jung's hypothesis. By faithfully I understand Jung to mean the mirror *always and everywhere* reflects whatever looks into it. In other words, dream contents are always an accurate reflection of the dreamer's inner state, albeit in a symbolic language, whenever one is dreaming.

If the mirror always and everywhere reflects the dreamer's inner state, then the hypothesis ceases being merely a hypothesis. It becomes a universally valid method of observation, a way of observing life accurately, although from the perspective of the unconscious, symbolically rather than literally. The established method of observation (as in the Spencer experiment) is via a questionnaire and the conscious mind. The two methods represent observation of a subject's inner state, via dream contents or autonomous and spontaneous productions of the unconscious, while the other focuses on productions of the conscious mind, as in the original experiment.

Jung saw the historical counterpart to analytical psychology in alchemy and its connection to the history of ideas stretching as far back as to ancient Egypt and funeral practices. In a parallel fashion, but more modestly, the 1619 quote (in Jung, 1944/1968) which heads up this article can be seen as the historical counterpart of the particular application of Chalmers's shared observation methodology that I am suggesting. By examining a given phenomenon from both the unconscious and conscious minds at once, the same kind of dual perspective is achieved. The author of *Wasserstein* tells us of a twofold seeing in which spiritual vision is allotted to spiritual things and the outer reality to its own. Presumably, in the same way that alchemy as a corpus provides the historical coun-

terpart of analytical psychology, so the Wasserstein approach can be seen as providing the historical counterpart of our particular use of Chalmers's shared observation methodology.

Inflections between Individuals and across Cultures

To be able to compare dream contents within a group of test subjects, we must determine what similarity means. We must also, for that matter, be able to say that the dream content of individuals in the control group will be verifiably different. Before answering this question, however, we also need to look at what Jung has to say about it.

Since analytical psychology is decidedly oriented towards the individual, the hypothesis that dream content faithfully or accurately depicts the dreamer's inner state bears closer examination by comparing dream content across a population of dreamers. No two individuals have exactly the same dreams. However, Jung (1948/1969) makes the claim that certain archetypal patterns or themes in dreams do occur across individuals and even across cultures.

Symbols representing the same archetype are expected to vary from culture to culture, indeed from person to person. They are, according to Stevens (1995), "the flesh in which the archetypal skeleton incarnates itself" (p. 182). The specific dream symbols are expected to be different from culture to culture, individual to individual. Basically, they are formed according to the person's life experiences, as well as the learning or understanding from these experiences. What is not expected to change is the archetype *per se*, the basic structure or meaning. The archetype is the armature, as it were, over which the changing clothes are thrown (as each individual's specific dream images related to that theme).

This distinction, between the archetype as a psychic structure constituting the mind and the dream images or symbols which that structure uses to represent itself in dreams, draws on Jung's distinction, described by Stevens (2002), that distinguishes between what Jung calls the *archetype per se*, the structure of the archetype, and the archetype as it represents itself to the mind as a specific image. Jung famously drew an analogy with the formation of crystals, in which the mathematical structure of the crystal is analogous to the archetype *per se* and the crystal as it actually forms compares to the specific image. Just as no two actual crystals are identical, no two individuals' dream symbols are precisely the same: Yet the same kind of crystal is being discussed. Stevens (2002) writes:

The charge of Lamarckianism forced [Jung] to make the very necessary distinction between the archetype-as-such

and the archetypal images, motifs and ideas that the archetype gives rise to, thus making it clear that he did not believe archetypes to be inherited *images*, but purely the inherent psychic *structures* responsible for the production of such images. (p. 51, italics added)

Stevens bases this discussion on Jung (1954/1968), who writes:

One must constantly bear in mind that what we mean by “archetype” is in itself irrepresentable, but that it has effects which enable us to visualize it, namely the archetypal images. (para. 417)

To summarize the argument so far. My proposal suggests that the established method of observation is the one in Spencer et al.’s (2004) experiment. A questionnaire as to a subject’s experienced levels of sexual desire is the main tool. The new, so-far-untested method is via dream contents recorded in a dream journal by each subject. Data from these two sources, one conscious, the other unconscious, are what will be compared. Both sets of data are to be gathered when the subjects are exposed to human exocrine or breastfeeding compound in order to artificially stimulate sexual desire. Control subjects are to be exposed to a placebo. In the exposed subjects’ dreams, we would expect to see the same lover-archetype represented (Haule, 1990). However, we are expecting this archetype to be individually inflected according to each individual subject’s culture and life experiences.

Pre- and Post-Validation

With shared observation methodology, there is significant difference between the pre-validation and the post-validation perspectives. Before validation of the new method of observation, any new method is controversial, precisely because it is untested. This was the case in the two historical instances of using the method of shared observations: Galileo’s validation of telescopic data as reliable (Chalmers, 1999, pp. 163–168) and the validation of radio telescope data in the 1950’s (Edge, 1976). We would expect the same controversy before being able to test Jung’s hypothesis about dreams.

What appears obvious *ex post facto* is by no means so *prior* to the shared observation taking place and successfully being completed. An eloquently described instance of this is the history of validating radio telescope data and observation: “Around 1950 or so there appeared to be an optical Universe and a radio Universe which were utterly different,

which co-existed. So there was obviously a need to tie them together somehow" (Edge, 1976, p. 269).⁵

Similarly there are two perspectives at work in the proposed modification of the Spencer experiment: from a Jungian perspective there is an unconscious or inner reality, but we also have the culturally validated mainstream experience of a consciousness of specific outer reality. As with the optical and radio universes pre-1951, these two realities certainly co-exist, but at times at least, they appear utterly different. Perhaps this is less so from a Jungian perspective. However, from a mainstream perspective it is clear that an inner reality, based on the existence of an objective psyche, is usually denied. It is precisely at this point that the proposed experimental design can help.

Jung refers to this gap in understanding, even mentioning a parallel with Galileo's situation. He does so when commenting on a medical diagnosis he made of another doctor's patient based on a dream of the patient's.⁶ He writes:

We see them [physical and the psychological dimensions] as two on account of the utter incapacity of our mind to think them together.⁷ Because of that possible unity of the two things, we must expect to find dreams which are more on the physical side than on the psychological, as we have other dreams that are more on the psychological than the physiological side. . . . I had to speak in terms of the basic mind, which thinks in archetypal patterns. When I speak in terms of archetypal patterns those who are aware of such things understand, but if you are not aware, you think, "This fellow is absolutely crazy because he talks of mastodons and their difference from snakes and horses." I should have to give you a course of about four semesters about symbology [*sic*] first so that you could appreciate what I said. That is the great trouble: There is such a gap between what is usually known of these things and what I have worked on all these years. . . . Only when you possess that apparatus of parallelism can you begin to make diagnoses and begin to say that this dream is organic, and this is not.⁸ Until people have acquired that knowledge, I am just a sorcerer. They say it is a *tour de passe-passe* [sleight of hand]. They said it in the Middle Ages. They said, "How can you see that Jupiter has satellites?" If you reply that you have a telescope, what is a telescope to a medieval audience? (Jung, 1935/1976, paras. 136–139)

The Spencer experiment of artificially inducing sexual desire provides one area of overlap where these two ways of perceiving one's inner state can be tested in a controlled manner.⁹ It does so by contrasting findings from the unconscious and the conscious minds in the experimental as well as the control-group subjects.

Procedure for Modifying the Spencer Experiment

The specific modification of the Spencer experiment would consist of asking the test subjects to write down their dreams throughout a 90-day period: through the 30 initial days when a placebo compound is applied as well as the 60-day exposure to the breastfeeding compound. Everything else is to be repeated exactly as in the original experiment.

From the results of the Spencer experiment, we know that breastfeeding compounds (exocrine compounds) from breastfeeding women have the effect on nulliparous young women of increasing sexual fantasy in those who are unpartnered as well as increasing sexual activity in those partnered. By adding the collection of dreams from the experimental group's journals, I predict a strong and repeatable correlation between the two sets of data.¹⁰

The expectation is also that we will see the same archetype represented, but with the specific dream imagery individually inflected, that is, the same lover-archetype but not the same specific individual dream images. Commonly, the specific dream image would be of an actual person who has played that archetypal role in the life of the dreamer.¹¹

The prediction is therefore that completely different, individual dream images around different archetypes will occur in the dreams of *all* subjects in the initial 30 days (when both groups of subjects receive placebos) and in the dreams of those in the *control group only* during the final 60-day period. Specific dream imagery will be different for each individual dreamer, depending on issues active in their lives at that time. What should change consistently, however, is that the dream themes should be *constant* across the group exposed to the breastfeeding compound during the final 60 days. The dream images for the exposed group should exhibit the same lover-archetype, albeit individually inflected.

The reason for predicting the constant change across the exposed group is the expectation that their dream themes would be affected uniformly from the exocrine substance. In the control group, different individual issues in the lives of the women not artificially exposed would account for the distinctly differing dream themes affecting their lives at that time.

In short, themes in the dreams of the control group should vary widely throughout the experiment, whereas in the exposed group for the

last two months the lover archetype should figure prominently and consistently in their dreams. The only expected deviation from this prediction would be if a woman in the control group actually was in love. The lover archetype would then be activated without any artificial stimulation from the breastfeeding compound and independent of the experiment.

Notes

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1. This is the experience of the ego being confronted or overtaken by the Self. Falling in love is obviously one example. The autonomous activity of the Self is as much *corporeal* as spiritual or psychological. For sexual desire and Eros treated in an archetypal manner, see Jung's (1946/1966) treatment of the Rosarium illustrations in "The Psychology of the Transference." See also the next endnote.
2. Jung (1944/1968), in "Introduction to the Religious and Psychological Problems in Alchemy," quotes: "The bruised reed he shall not break, and the smoking reed he shall not quench" (Isa. 42:3), which illustrates the sensitivity and tact needed in approaching this aspect of Jungian psychology. See also Edinger (1995a, pp. 225–227). For the present concern of sexual desire and its numinosity, see the work of American analyst John Haule (n.d.), particularly his idea of meditation as applied to any concern, however seemingly exalted or mundane.
3. See Appendix 1 for two other possible approaches for further research.
4. See footnote 6 below for examples and references.
5. The quote is from an unnamed astronomer working at the time.
6. See the example of the dream of the miniature mastodon (Jung, 1935/1976, para. 138); the treating doctor's case notes of this case can be found at Davie (1935). For another example of a medical diagnosis from dream content, see Jung (1934/1966, paras. 343–350).
7. Note that Jung gave this Tavistock Lecture in 1934, and this "unthinkability" point does not reflect Jung's later (1950–60) work on the *unus mundus* for example. For the *unus mundus*, see Jung (1954/1970, paras. 759–775). For Jung's own experience of the *unus mundus*, see Von Franz (1975, chap. 12). Since this observation pertains to the larger philosophical question, I leave it to one side however.

8. What Jung appears to discuss here is a psychophysical parallelism as seen through dream imagery and comparative symbolism.
9. See Appendix 1 for two other proposals for testing Jung's hypothesis.
10. By this I mean that the dream themes or archetypes should be the same across the women exposed to the breastfeeding compound. However, specific imagery (though referring to the same theme) will vary from dreamer to dreamer. See the section on cultural and individual inflection of dream images above.
11. In Jungian terminology, the person who carries the imago of the lover.

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Appendix 1

Here are two more ways of testing Jung's hypothesis. The first involves pregnancy and an article of mine in *Women and Birth* (Keenan, 2008). Methodologically it is quite similar to the modified Spencer experiment described above. However, it is more complex and more expensive. The second approach involves spontaneous healing of physical brain trauma. Healing patients would be asked to record their dreams; this new method of observation data is then compared to various types of brain scans to find any strong repeatable correlations. This test may be easier to carry out if done in existing treatment of patients without undue disruption. (Unlike the modified Spencer test, neither of these additional tests involves inducing artificial states in a subject which could be regarded ethically reprehensible.)

Appendix 2

For references to dream and hallucination content referring accurately to outer reality, see descriptions of episodes in the lives of scientists and mathematicians such as Nobel laureate Otto Loewi, inventors Elias Howe and Trevor Baylis, mathematicians Srinivas Ramanujan, Henri Poincaré, and Jacques Hadamard, paleontologist Louis Agassiz, and chemists August Kékulé and Dmitri Mendeléev. Some reference works include:

Agassiz: Elisabeth Cary Agassiz, *Louis Agassiz: His Life and Correspondence*. Vol. I. Boston: Houghton Mifflin and Co., pp. 181–183. Agassiz's own account can be found in Louis Rodolphe Agassiz, *Recherches sur les Poissons Fossiles*. Vol. IV, tab. 1. Neuchâtel, 1836, pp. 20–21.

Baylis: See Baylis's autobiography, *Clock This: My Life As an Inventor*. London: Headline, 1999, pp. 198–199.

Hadamard: See Jacques Hadamard, *The Mathematician's Mind*. Princeton: Princeton University Press, 1996, pp. 8 & 10n.

Howe: See Waldemar Kaempfert, *A Popular History of American Invention*. Vol. II. New York: Scribner's, 1924, p. 385.

Kekulé: See Marie-Louise Von Franz, *Projection and Recollection in Jungian Psychology*. Wilmette, IL: Open Court, 1980, pp. 69–70. Von Franz cites from R. Anschutz, *August Kekulé*, Vol. II, Berlin: 1929, p. 941 passim.

Loewi: See Eliot S. Valenstein, *The War of the Soups and Sparks*. New York: Columbia University Press, 2005, pp. 57–58.

Mendeléev: See Paul Strathern, *Mendeléev's Dream*. London: Penguin, 2000, p. 282.

Poincaré: See Henri Poincaré, *Science et Méthode*. Paris: Flammarion, 1920, chap. 3.

Ramanujan: See Robert Kanigel, *The Man Who Knew Infinity: A Life of the Genius Ramanujan*, New York: Scribner's, 1991, p. 169, for one example of what would appear to be a lifelong modus operandi of working from dreams rather than just one or two isolated examples.