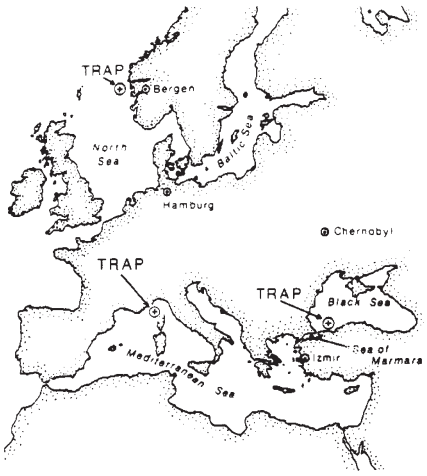

Map of Europe showing Chernobyl and the sites where Chernobyl-fallout radionuclides were collected with deep-sea sediment traps.

in both the North Sea and the Mediterranean Sea had, serendipitously, already been set for other purposes and had begun their sequential sampling at the time of the Chernobyl accident. In both cases it required less than 10 days for the pulse of fallout to reach 200 metres in depth, implying that the arriving particles had a sinking speed of at least 20 metres per day. That figure is within the range of values reported for the faeces pellets produced by zooplankton, and Fowler *et al.* argue that zooplankton faeces represent the principal pathway by which the Chernobyl fallout nuclides were transported downwards in the water column.

The idea that herbivorous zooplankton play an important role in accelerating the sinking of particulate matter in the oceans is not new. Evidence was first presented by C. Osterberg *et al.* (*Nature* **200**, 1276–1277; 1963) at a time when large releases of radionuclides into the atmosphere were a regular occurrence. Short-lived fission products from nuclear-weapons tests were detected in sea cucumbers living 2,800 metres deep off the coast of Oregon, requiring the existence of a mechanism that would deliver them to that depth in a matter of days or weeks.

The observations of the Chernobyl fallout are a direct demonstration of the operation of such a mechanism. It is now widely accepted that most of the vertical flux of particles in the ocean is caused by relatively rare large particles that are aggregates of one kind or another, and not by the more abundant fine-particle background. Much current research effort is aimed at understanding the origin and dynamics of large amorphous aggregates, often called 'marine snow', whose role in transporting materials downwards in the oceans is less well understood than that of the identifiable faecal pellets. □

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Therapy and the ideal of chemistry

"To analyse the patient — that is to separate his mental processes into their elementary constituents and to demonstrate these instinctual elements in him singly and in isolation". These are the words Freud used[1] to make an analogy between psychoanalysis and chemical analysis. It is immediately obvious that the analogy relates to technique — to separate and to isolate — and thus refers less to chemistry in general than to Lavoisier's definition of chemistry as an operational science and of the chemical 'facts' as those that have been 'purified' from all uncontrollable circumstances.

But the history of chemistry reveals that implementing Lavoisier's ideal so that chemistry could stop being an interpretative 'art' requiring the experience of a lifetime as described by the chemist Venel[2], and become a methodic practice where knowledge and action have a harmonious relationship, mainly occurred because

Men at work — Freud (by Max Pollak) and Lavoisier (by P. Fouché)

nineteenth-century industry did produce the 'pure' reproducible products and the instruments such a practice needed. How could psychoanalysis make a similar break with the old interpretative art of traditional therapy to become a professional activity guided by a codified technique?

This problem is strongly connected with that of hypnosis. It is remarkable that Lavoisier himself was involved in the first discovery of the "power of imagination". He was part of the Royal Commission[3] which concluded that the universal 'fluid' by which the magnetist Mesmer explained the collective (hypnotic) crisis he provoked did not resist methodic investigation by separation and isolation. Indeed, the commission used 'placebo' methods to demonstrate that when imagination is purified away, the phenomenon disappears or becomes erratic. A century later (1885–1886), Freud learned from Charcot[4] that hypnosuggestion could give him a power like that of chemists: it could do and undo pathological symptoms just as the chemist composes and decomposes substances.

"Psychoanalysis proper began when I dispensed with the help of hypnosis", wrote Freud later[5]. Indeed, he had discovered that hypnosis did not give the power of control over his patients needed to verify the truth of his explanatory hypotheses, as they could lie or resist. Hypnosuggestion could not be purified from a complex of affective, unconscious factors which distorted the influence of the therapist. The solution Freud found for this problem is well known: he transformed this complex, the transference relationship, from an obstacle into a tool. It is the progressive elucidation of this relationship which must achieve the purification process, the production of actors able to verify without resistance the validity of scientific hypothesis.

Today, the problem of hypnosis has surfaced again. As Freud himself said[6], many analysts recognize that the ideal of conquering the resistance of patients, of dissolving transfer, is not operational. Instead of being purified away the affective, unconscious ties seem to be uncontrollably amplified by the psychoanalytical setting. In such a setting, the instalment of unrecognized hypnoid states could even be common. Contrary to Freud's hopes and to the example of chemistry, psychoanalysis has not succeeded in breaking completely with the old uncertain art of therapy.

Two centuries after Lavoisier, it is time for therapy to renounce the epistemological ideal of chemistry, of purification and isolation, to face the problem of what we call imagination or influence. This implies the meeting of many disciplines as it is clear that the problem is indissociably physiological, ethological, psychological and social. If freudian psychoanalysis has not succeeded in becoming a science, it is not because it is not rational enough, but because the relevant rationality is still to be invented.

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