Web Ecology 7: 27–34.

Arthur G. Tansley's 'New Psychology' and its relation to ecology

Joachim L. Dagg

Dagg, J. L. 2007. Arthur G. Tansley's 'new psychology' and its relation to ecology. – Web Ecol. 7: 27–34.

In 1935, A. G. Tansley, who was knighted later, proposed the ecosystem concept. Nevertheless, this concept was not without predecessors. Why did Tansley's ecosystem prevail and not one of its competitors? The purpose of this article is to pin the distinguishing features of Tansley's ecosystem down, as far as the published record allows. It is an exercise in finding the difference that made a difference. Besides being a pioneering ecologist, Tansley was an adept of psychoanalysis. His interest even led him to visit Sigmund Freud in Vienna for a while. Psychologists had to regard the mind as an entity in its own right, while knowing that it truly was part of a larger whole (body + mind), because the causal relation between body and mind was unknown. This lead Tansley to conclude that psychologists must not objectify the system under study, have to search for causes within their own field, and must not speculate unless this serves a scientific purpose. In 1925, Tansley defended psychoanalysis in a prolonged controversy against a concerted attack criticizing its speculative content and poor scientific standing. This could have been the reason why Tansley kept his ecosystem free of speculative content and unscientific connotation. The competing ecosystem-like concepts, however, have contained philosophical speculation, non-deterministic properties like vitalism or entelechy, or have been burdened with unscientific connotations. Hence, rigorous restraint distinguished the ecosystem concept and made it ready for use by later researchers.

J. L. Dagg (jdagg@gmx.de), Falkensteiner St. 20, DE-65760 Eschborn, Germany

Arthur Gorge Tansley (1871–1955) is most famous for suggesting the ecosystem concept in 1935, but has not coined the term. A. Roy Clapham suggested it in the early 1930s, when Tansley asked him if he could think of a suitable word to denote the physical and biological components of an environment considered as a unit (Willis 1997).

Before 1935, Tansley (1920, p. 122) had accepted the organism analogy in ecology (Clements 1905, p. 199; 1916, p. 3) as a heurism, because it emphasized that vegetation is not as static as the mapping of plant formations seemed to suggest (Hagen 1992). Phillips (1934; 1935 a, b), however, had mixed the popular organism analogy with the holistic philosophy of Jan Christian Smuts (Anker 2001). Tansley rejected this as an "exposition of a creed–of a closed system of religious or philosophical dogma" (Tansley 1935, p. 285), while Clements (1936) agreed with Phillips. Even after rejecting this literal interpretation of biotic communities as organisms, Tansley did not become dogmatic about analogies: "We can, if we want, call the ecosystem an organism because it shows organization, just as some philosophers, for example Whitehead, call the universe an organism. But most biologists will prefer to restrict the term, as they have been accustomed to do, to the individual animal or plant" (Tansley 1939, p. 518).

Accepted 5 February 2007
Copyright © EEF
ISSN 1399-1183

Other ecological concepts, like community, formation, association, or biocoenosis resembled Clements's organism analogy in treating biotic parts as the units of research. Against this widespread habit, Tansley insisted (1935, p. 299, emphases as in original): "But the more fundamental conception is, as it seems to me, the whole *system* (in the sense of physics), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome–the habitat factors in the widest sense. […] These *ecosystems*, as we may call them, are of the most various kinds and sizes."

Nevertheless, the term 'ecosystem' has not been without competitors. For example, Stephen Forbes (1880, p. 19; 1887) had explicitly incorporated all biotic and physical attributes of a lake in a single entity, which he had called a 'microcosm' (McIntosh 1985, p. 195; Golley 1993, p. 36; Croker 2001, p. 126). Although J. S. Haldane had not coined a term in 1884, he claimed the unity of individual organisms and their environment (Jax 1998, p. 113, note 1). The German ecologists Thienemann, Friederichs, and Woltereck, have addressed ecosystems as 'Lebenseinheiten' (life units), 'holocoens', and 'ökologische Gestaltsysteme' (ecological gestaltsystems) in 1916, 1927, and 1928 respectively (Jax 1998). Even Arthur G. Tansley and Thomas F. Chipp have anticipated the more inclusive conception of the ecological unit in 1926, without coining a term, in 'Aims and Methods in the Study of Vegetation' (Anker 2001, p. 37). No matter under which name, these systemic concepts allowed ecologists to fathom in one thought what has otherwise been divided.

Tansley (1935) only refers to Levy (1932) as a source for his systemic thinking. Levy (1932, p. 45) has indeed claimed that: "Science, like common sense, sets out in the first instance to search for systems that can be imagined as isolated from their setting in the universe without appreciably disturbing their structure and the process they present." Nevertheless, this book about the philosophy of science does not address ecology and nothing in it suggests singling out a system that was more inclusive than vegetation or a community.

In 1920, Tansley published a book intended for the general reader on 'The New Psychology and its Relation to Life'. It rushed through ten impressions in five years, selling ten thousand copies in the UK and over four thousand in the USA (Cameron and Forrester 2000). After a career-break as an ecologist in England, he visited Sigmund Freud in Vienna two times, for three and six months respectively, during 1922–23. Back in England, he started to practice as a psychoanalyst, but soon he abandoned that occupation and went back to ecology. Cameron and Forrester (1999) and Anker (2001, chapter 1) provide more detailed historical accounts of Tansley's interest in psychoanalysis. Here, I suggest that Tansley's experience in psychology was intellectually important for his ecosystem concept.

A difference that made a difference

Psychology has been a special science in one respect, the ignorance about the causal relation between mind and brain or body. Ever since Descartes, the mind/body dualism prevailed. Tansley drew several dire lessons from this impasse.

1) *Heuristic approach vs reification*. In order to get on with their business, psychologists had to treat the mind as an entity, while knowing that it was part of a more inclusive natural unit including mind and body. "We are thus driven to consider the psychical sphere separately from the physical sphere, as a distinct field for scientific investigation, with data, concepts and laws of its own. We must not mix up physiological and psychical terms and conceptions, as is so often done by popular writers. Such a phrase […] as "a thought flashed through my brain" is quite illegitimate" (Tansley 1925, p. 26).

2) *Determinism vs vitalism or entelechy*. Unable to explain mental phenomena in terms of physiological ones, psychologists had to look for causes within the psychic sphere. "It is clear that if we are thus to recognize the mind as a distinct subject of scientific investigation, the law of causation must hold within the psychic sphere, for without postulating the law of causation science is impossible" (Tansley 1925, p. 27).

3) *Empiricism vs speculation*. As long as no method for studying the relation between mind and body was in sight, psychologists should not speculate about it. "To the plain man it seems clear that physical and mental phenomena form parts of the same chains of causation. The point is that the transition from the one kind of phenomenon to the other is entirely obscure and that no useful scientific purpose is served by speculation about its nature" (Tansley 1925, p. 29).

4) *Utility*. Models of the mind are legitimate, if they help understanding. While this seems to contradict lesson three at first sight, speculation is permissible if it serves a useful scientific purpose. "In attempting to deal with the mind by scientific methods we are faced with the necessity of making conceptual constructions in which spatial relations are involved. It is obvious, of course, that the mind is not extended in space, and the use of such constructions may be held to be illegitimate. The practice can be defended on the ground that any conceptual construction may be held to be an expedient if it helps us to classify phenomena and to obtain a clearer insight into their relations" (Tansley 1925, p. 31).

These features also distinguished the ecosystem concept from earlier ecosystemic ideas: 1) Tansley's heuristic approach prevented him from objectifying communities, unlike Clements or Phillips. 2) He did not infuse the ecosystem with a vitalistic, emergent, or otherwise non-deterministic principle, unlike the ecosystemic conceptions of Thienemann, Friederichs, and Woltereck (Jax 1998). 3) Tansley did not speculate about the structure and function

of ecosystems, unlike Forbes (1887), who filled his microcosm with Spencerian philosophy (Kingsland 1995, pp. 16–17). An anonymous reviewer suggested adding the 'Landschaft' (landscape-unit) of Siegfried Passarage, which seems to have been burdened with anti-Semitic connotations. This corroborates the conclusion that a lack of speculative content and unscientific ballast distinguished Tansley's ecosystem from other ecosystem-like concepts. 4) Tansley's ecosystem concept was empty in the above respects and later researchers could readily utilize it, as done by Lindeman (1942).

In 1925, Tansley also defended psychoanalysis against criticism about its speculative content and low scientific standing (Forrester 2003). While Tansley's peers and his followers received the ecosystem concept as inspired by physics rather than psychology (Golley 1993), it seems more likely that the lessons learned from psychology are the reason why Tansley kept his concept free of speculative content and non-scientific connotation.

Things that made no difference

Bateson (2000, pp. 272, 315 and 489) defines information as a difference that makes a difference, and Dawkins (1982, p. 112) admits that "phenotypes are not caused by genes, but only phenotypic differences caused by gene differences."

Hence, it takes a difference to explain a difference. This is also true for the difference between Tansley's ecosystem concept and other ecosystemic ideas that have been forgotten. What we need is a difference between psychology and other sciences that could have made the difference between Tansley and other ecologists. Therefore, reference to ideas that have been widespread among Tansley's fellows cannot explain, why his ecosystem concept prevailed and not someone else's. This excludes very general ideas that have been applied in psychology as almost everywhere else or by Tansley and many other ecologists.

Some metaphors and ideas have been pervasive, such as the mind as a machine or organism (the two were not contradictory then), and energy flowing towards equilibrium as dictated by the second law of thermodynamics. They were neither specific to psychology among sciences nor to Tansley among ecologists. Herbert Spencer and others have popularized these ideas (Kingsland 1995, pp. 14–16; Dagg 2003), which have been common stock in pop-science writing ever since.

Peder Anker (2001, p. 25) suggests that Tansley has developed his ecology through analogies with his psychology, but only mentions ideas that cannot, by the above criteria, have made a difference. For example, Tansley (1925, p. 57) described the mind as a network of mental elements connected via associations. This cannot explain why he included physical factors besides the organisms in his ecosystem concept. Such a network analogy could as well have led Tansley to food web concepts excluding physical factors. While Tansley may have drawn a network analogy, the direction of analogical transfer may as well have been the reverse. Ecologists commonly noticed the interconnectedness of species in a community (Forbes 1887), and Tansley probably also did.

Although research on neural networks dates back to 1873, it does not seem to have been important for early psychoanalysis and has even been ignored by neurophysiologists (Wilkes and Wade 1997). Neural network modelling only gathered momentum in the 1940s and neurophysiology rather than psychoanalysis inspired it. Tansley's late book on psychology is devoid of the mental networks and illustrations of it. Instead, Tansley (1952) calls the mind an 'aggregate of mental functions', like perception, thought, emotion, and conation. Tansley (1952, chap. 3) maintains the idea of psychic energy as the content of the mind, but the network is no longer part of its structure. Concerning the structure of the mind, Tansley (1952, chap. 2) distinguishes three levels of mental material (conscious, preconscious, and unconscious) and three dominant psychical 'instances' (ego, id, and super-ego). Tansley (1925) also introduced this structure in his early work on psychology, but the network concept seems to have been his personal addition facilitating his entry into a field that was new to him. Therefore, it seems likely that Tansley introduced the network concept to psychology, but it did not catch on among psychoanalysts. The article 'Tansley's psychoanalytic network' by Laura Cameron and John Forrester (2000) is not dealing with this network concept of the mind but with a group of scientist that was important in establishing psychoanalysis in England.

Shortly after the first publication of his early book on psychology, Tansley (1920) compared the analogy between human communities and organisms with that between plant communities and organisms. He thus exploited the former analogy for unifying the classification of vegetation. Anker (2001, p. 29) took this as evidence for a simple transfer from psychology to ecology by Tansley. Nevertheless, the analogy of human communities to organisms reaches back to Hobbes's Leviathan, it was popularised by Herbert Spencer ('Principles of Sociology') and others and was one of the most commonplace notions at the time.

Ideas such as energy flowing through a network are part of Tansley's psychology but not of his ecology (Tansley 1920). This is because Tansley was concerned with surveying vegetation, ecological studies of succession, and of the relationships between vegetation and habitat factors such as climate or soil (Schulte Fischedick 2000). The methods of this research program were observing, collecting, identifying, mapping, repeated records (censuses) of stationary quadrates, recording transects, and growing seeds in different soils. As plants do not eat each other, animal ecologists have developed the ideas of energy flowing though a network or food web (Elton 1927). It is therefore unlikely that

Tansley introduced them to ecology via analogous transfer from psychology.

In 1922, Tansley published a textbook called 'Elements of Plant Biology' intended for medical students. Anker (2001, p. 30) claimed that "This book represents a continuation of his mechanistic psychology, now expanded to the mechanism of plants. Given that the audience for the book was medical students, he could freely introduce a whole set of psychological terminology in the field of biology." As evidence for this, Anker (2001, p. 30) provides two quotes from the book: "All living organisms may be regarded as machines transforming energy from one form into another, for instance, from the *potential energy* locked up in the molecules of organic food to the *kinetic energy* seen in motion of the body…" (Tansley 1922, p. 25); and "This is an expression of the general physical law that all systems tend towards equilibrium" (Tansley 1922, p. 55).

In their proper context, however, these quotes only credit the laws of thermodynamics, which no scientist of any discipline can breach. The first quote is a machine metaphor on the first law of thermodynamics (preservation of energy). The specification of these machines as energy transformers was very fashionable at that time (Lotka 1925). The second quote follows this explanation of diffusion: "If a strong (concentrated) solution of a crystalloid is brought into contact with a weak (dilute) solution of the same crystalloid in the same solvent, diffusion proceeds until the solute is equally distributed through the whole of the liquid" (Tansley 1922, p. 55). Hence, it merely states the second law of thermodynamics.

The rest of this book is largely about plant physiology (proteins, fats, carbohydrates, osmosis, photosynthesis, respiration, fermentation, excretion, movement, reproduction, walls, protoplasm, nucleus, mitosis, chloroplasts), life forms and life history (amoebae, bacteria, fungi, liverworts, mosses, etc.), differentiation (germ line and soma, tissues and organs). All these have been well known issues of botany that needed no input from other disciplines. Any undergraduate student will recognize these issues, still, in her own curriculum, although the knowledge about them is far more sophisticated today. Nevertheless, the knowledge of these issues has already been too advanced in the 1920s to require sweeping analogies.

The only synecological passage of the book introduces no psychological terminology. Tansley (1922, p. 153) states "that a constant circulation of nitrogen is always going on in nature, through the agency on the one hand of various kinds of bacteria which break down the complex substances into simple ones, and on the other of green plants which build them up again into complex ones. In this circulation the animals play a comparatively small part, for they merely convert the plant proteins into the proteins of their own bodies. Besides the circulation of nitrogen there is also a circulation of carbon…" This hint at biogeochemical *cycles* should not be mistaken with the *network* metaphor Tansley applied in psychology.

The only sweeping statement reminiscent of Spencer's philosophy appears in the conclusion. Tansley (1922, p. 402): "In all this we see varied special cases of the great universal law of equilibrium, which governs all the processes of which we have any knowledge, from the movements of the planets to those of molecules, atoms and electrons, from the activity of protoplasm to the vagaries of the human mind." He even specifies this equilibrium as a 'moving equilibrium', which is a central concept of Herbert Spencer and roughly synonymous to steady state or dynamic equilibrium (Dagg 2003). Conclusions often try to place the previous into a wider context. The balance-of-nature philosophy captured in this quote has been pervasive, and the singular mention of the human mind in this context should not be taken as evidence for an analogical transfer from psychology.

New Psychology

Tansley's continued engagement with psychology lead him to write a book called 'The New Psychology and its Relation to Life'. First published in 1920, it rushed through ten impressions within five years (Tansley 1925) and was even used as a textbook by students, although Tansley intended it as a popular book for a broad readership.

The first chapter begins with a characterisation of the 'new psychology' in comparison with the 'older psychology'. Accordingly, the subject-matter of the older psychology was almost entirely concerned with the content of consciousness and with introspection as almost its sole method. The result was a great over-emphasis of the purely rational faculties of the mind. Unfortunately, Tansley (1925) does not refer to any particular author. He might have meant the so called school of introspectionism founded by Wilhelm Wundt around 1870 (Vermersch 1999). In 1932, he mentioned positively William James's 'Principles of Psychology' that has been published in 1890 (Tansley 2002). Herbert Spencer's 'Synthetic Philosophy' also consisted in part of 'Principles of Psychology' (Spencer 1880). It is known that Tansley had admired Spencer as a juvenile (Godwin 1977, p. 19), and had later helped editing the second edition of his 'Principles of Biology' (Spencer 1898, acknowledgements).

The new psychology has discovered the unconscious through studying the irrational, abnormal, and pathological by means of association. It also draws from the study of animal and human behaviour, art, mythology, habits and customs of primitive people. Tansley (1925, p. 24) wrote that "The New Psychology, then, looks upon the human mind as a highly evolved organism, intimately adapted, as regards its most fundamental traits, to the needs of its possessor, built up and elaborated during a long course of evolution in constant relation to those needs, but often showing the most striking want of adaptation and adjustment to the rapidly developed and rapidly changing demands of

modern civilized life. Its most fundamental activities are non-rational and largely unconscious activities."

The second chapter of 'New Psychology' runs straight into one of the oldest philosophical problems, our ignorance about the relationship of mind and body. This problem justifies a heuristic attitude that treats the mind as if it was isolated from the body (and the brain). The rationale of this heuristic reappears in condensed form in the conclusion at the end of the book: "The mind is a living organism, or rather it is part of the organism as a whole, a part we have to consider separately because we cannot state or appreciate accurately its relation to the body" (Tansley 1925, p. 289).

The third chapter introduces a series from an explosive discharge of energy (Tansley 1925, Fig. 1, see Plate 1) to specific responses in the simplest organisms (Tansley 1925, Fig. 2, not shown here), reflex actions (Tansley 1925, Fig. 3, see Plate 1), instincts (Tansley 1925, Fig. 4, see Plate 1), and higher mental processes (Tansley 1925, Fig. 5, not shown here). In Tansley's Fig. 4 and 5, the mind is akin to a combustion chamber of a machine and its energy is controlled and coordinated by channels and pipes.

Chapter four and five introduce the unconscious and the metal complexes as parts of an associative network of mental elements (Tansley's 1925, Fig. 7 and 8, see Plate 2).

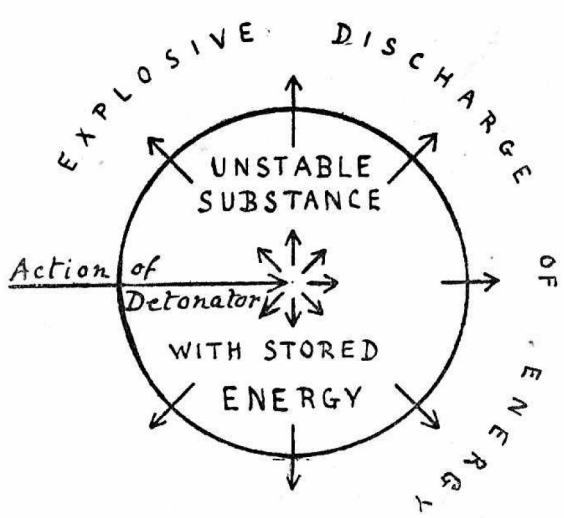

FIG. 1.—DISCHARGE OF ENERGY FROM UNSTABLE SUBSTANCE (HIGH EXPLOSIVE) STARTED BY THE ACTION OF A DETONATOR.

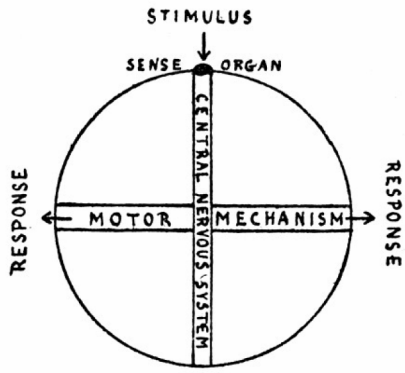

FIG. 3.—SPECIFIC RESPONSE. TYPE OF REFLEX ACTION.

FIG. 4.—SPECIFIC RESPONSE. TYPE OF INSTINCTIVE ACTION WITH PSYCHICAL CONCOMITANTS. The space within the inner circle represents the mind, that between the two circles the body.

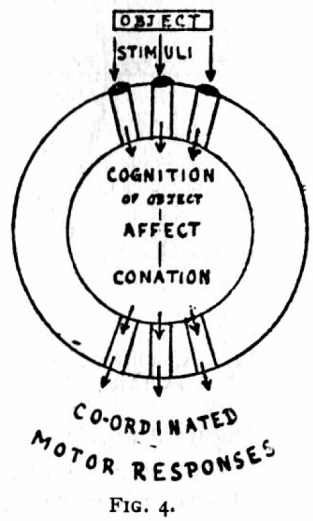

FIG. 4.

Plate 1. Illustrations and original captions of the machine metaphor of the mind (Tansley 1925, chap. 3).

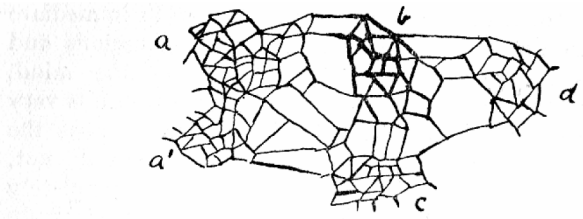

FIG. 7.—PART OF THE ASSOCIATIVE NETWORK OF THE MIND SEEN, AS IT WERE, IN SURFACE VIEW (compare Fig. 8, p. 61). Five complexes are shown, of which *a'* is a branch or sub-complex of *a*. The complex *b*, heavily lined, is supposed to be in a state of activity.

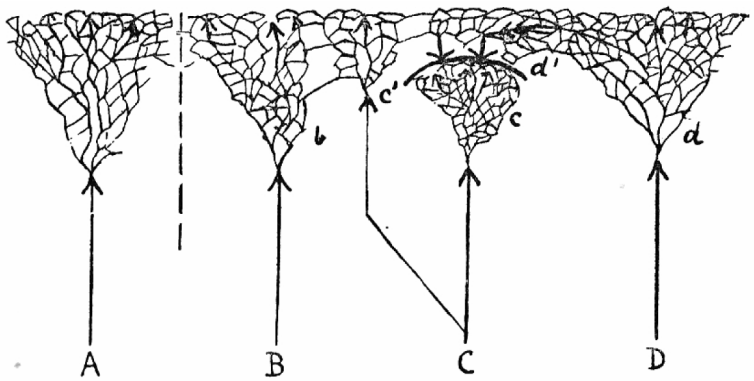

FIG. 8.—RELATIONS OF DIFFERENT COMPLEXES TO ONE ANOTHER AND TO THE ACTIVATING INSTINCTS (SECTIONAL VIEW). A, instinct activating complex *a* which is segregated in a compartment of the mind, but in which the mental processes and outlets are normal. B, instinct activating complex *b*, which has normal connexions with the rest of the mind. C, instinct activating two complexes, *c* and *c'* : *c* is repressed by *d'*, a branch of *d* giving rise to conflict along the curved line representing a "shell" of repression : the energy of C, having no escape through *c*, finds a partial outlet through the weak substituted complex *c'*. D, instinct activating complex *d*, a branch of which, *d'*, uses part of the energy derived from D to repress the complex *c*.

Plate 2. Illustrations and original captions of the network metaphor of the mind (Tansley 1925, chap. 5).

Psychic energy (the libido) that tends towards equilibrium fills this structure of the mind (chapter 6). With this in place, Tansley (1925) expands on diversion, sublimation, regression, conflict, repression, dreams, projection, psychical segregation, rationalization, ego complex, herd instinct, sex instinct and complex, and other psychological phenomena.

Peder Anker (2001, p. 25) argued that Tansley projected this model of the mind as energy flowing through an associative network into ecology. While contemporary ecologists will indeed recognize the gist of an ecosystem in a model of energy flowing through a network, Tansley never used energy nor network in his ecological writings.

He did use organism and machine metaphors that were pervasive at the time. The fact that these analogies can also be found in the psychological literature of Tansley's time and before cannot be taken as evidence for a projection from psychology to ecology by Tansley. For example, Spencer's Principles of Psychology (1880) contain a similar machine metaphor with energy flowing in channels and it does contain an organism metaphor. This peculiar analogy of the mind as an organism can also be found in Tansley (1925, pp. 24, 82, 88, 96, 98, and 289). Organism and machine analogies were not seen as contradictory. Tansley neither used the network nor energy analogy in his formulation of the ecosystem concept. Combining energy with the ecosystem concept, however, is an achievement of Lindeman (1942). Therefore, a simple analogical transfer should not be postulated without further evidence.

Dualism and heuristics

Peder Anker (2002) prepared a hitherto unpublished manuscript for publication, which Tansley has presented

to the 'Magdalen Philosophy Club' of Oxford University in 1932. A few quotes from this essay can illustrate why Tansley regarded the mind/body problem as special in the general scheme of science: "This is the only account I can give of the first gap in the genetic series, the gap between the not-living and the living. It is, of course, a purely mechanistic account and amounts to a denial that the gap is unbridgeable in terms of chemistry and physics" (Tansley 2002, p. 617). "The first gap, between the inorganic and the organic, I have attributed to lack of knowledge, an ignorance that we may possibly, perhaps probably, never surmount, but that I do not believe is theoretically unbridgeable by human knowledge" (Tansley 2002, p. 624).

"We cannot hope to bridge the gap between the physiological and the psychical because all our knowledge is founded on the very power we seek to interpret" (Tansley 2002, p. 618). "The second gap, between the physiological and the psychical, I attribute to the fact that psychical awareness is the foundation of all human knowledge and the instrument through which we contemplate the external world and also our own minds. For that reason, it is impossible to understand awareness in terms of anything else, though its antecedents are clearly physiological perceptions that we can explain theoretically in terms of chemistry and physics" (Tansley 2002, p. 624).

Tansley accepted the problem of explaining the relation between mind and body as unsolvable (Tansley 1925, pp. 29–31). This has not been true for the relation between the living and the non-living. Tansley (2002) was sure that the gap can be bridged by mechanistic explanation at least in principle, though we may for empirical reasons never obtain comprehensive evidence of the evolution from inorganic to organic matter. The understanding of the actual interactions between organic and inorganic factors, however, had advanced a lot in Tansley's time. Their conceptual separation was no longer necessary, though he admitted its use for certain kinds of research.

Tansley's late work on psychology 'Mind and Life' is getting along without an organism analogy for the mind, though society is once called a super-organism (Tansley 1952, p. 51), and without the network analogy, but not without considering it an entity in its own right (Tansley 1952, p. 9). Hence, the heuristics of getting on with the business of psychology and employing certain analogies were only contingently connected.

Why have earlier ecosystem-like concepts not caught on?

Another issue is the question why other ecosystem-like concepts that were proposed earlier, like the microcosm, the Lebenseinheit (life unit), the holocoen, or the ökologische Gestaltsystem (ecological gestaltsystem), did not catch on and have been forgotten. We need a difference between the ecosystem concept and these other ecosystemic concepts that can explain this difference in reception.

Jax (1998) argued that the German Lebenseinheit, holocoen and Gestaltsystem have been standing in the tradition of Goethe rather than Newton. They were burdened with connotations of vitalism that prevented a rigorous research program. The proposed global (emergent) properties, like vitalism, did not lend themselves to experimental research. The microcosm (Forbes 1880, p. 19) came along with a claim for "taking a comprehensive survey of the whole as a condition to a satisfactory understanding of any part." However, Forbes took a bottom-up approach to this task. Species after species, he studied the stomach contents of fishes (Forbes 1880), beetles (Forbes 1883) and other organisms (Croker 2001). While holistic in his outlook, global properties never came into sight. Instead, Forbes filled this void with ideas inspired by Spencer such as a common interest of predator and prey species in a balance of destructive and reproductive forces (Forbes 1887; Kingsland 1995, pp. 14–17) and oscillations in population densities as a consequence of imperfect adjustment. In contrast, Tansley's did not burden his ecosystem concept with such cargo. It was free to be utilised in whichever way research would turn.

Acknowledgements – Thanks to Peder Anker for his encouraging comments.

References

Anker, P. 2001. Imperial ecology: environmental order in the British empire, 1895–1945. – Harvard Univ. Press.

Anker, P. 2002. The context of ecosystem theory. – Ecosystems 5: 611–613.

Bateson, G. 2000. Steps to an ecology of mind. – Univ. Chicago Press.

Cameron, L. and Forrester, J. 1999. 'A nice type of English scientist': Tansley and Freud. – Hist. Workshop 48: 65–100.

Cameron, L. and Forrester, J. 2000. Tansley's psychoanalytic network: an episode out of the early history of psychoanalysis in England. – Psychoanal. Hist. 2: 189–256.

Clements, F. E. 1905. Research methods in ecology. Reprinted in 1977. – Arno Press.

Clements, F. E. 1916. Plant succession. – Publication No. 242, Carnegie Institution of Washington.

Clements, F. E. 1936. Nature and structure of the climax. – J. Ecol. 24: 252–284.

Croker, R. A. 2001. Stephen Forbes and the rise of American ecology. – Smithonian Institution Press.

Dagg, J. L. 2003. A metaphor for Herbert Spencer's explanatory system. – The Victorian Web [http://www.victorianweb.org/philosophy/spencer/dagg2.html].

Dawkins, R. 1982. The extended phenotype. – Oxford Univ. Press.

Elton, C. S. 1927. Animal ecology; reprinted in 2001 with new introductory material by Mathew A. Leibold and J. Timothy Wootton. – Chicago Univ. Press.

Forbes, S. A. 1880. The food of fishes. – Bull. Ill. State Lab. Nat. Hist. 1: 19–70.
Forbes, S. A. 1883. The food relations of the Carabidae and Coccinellidae. – Bull. Ill. State Lab. Nat. Hist. 1: 33–64.
Forbes, S. A. 1887. The lake as a microcosm. – Bull. Sci. Ass. Peoria 1887: 77–87.
Forrester, J. 2003. "A sort of devil" (Keynes on Freud, 1925): reflections on a century of Freud-criticism. Österreichische Zeitschrift für Geisteswissenschaften 14: 70–85.
Godwin, H. 1977. Sir Arthur Tansley: the man and the subject. – J. Ecol. 65: 1–26.
Golley, F. B. 1993. A history of the ecosystem concept in ecology. – Yale Univ. Press.
Hagen, J. B. 1992. An entangled bank, the origin of ecosystem ecology. – Rutgers Univ. Press.
Jax, K. 1998. Holocoen and ecosystem – on the origin and historical consequences of two concepts. – J. Hist. Biol. 31: 113–142.
Kingsland, S. E. 1995. Modeling nature. Episodes in the history of population ecology. – Chicago Univ. Press.
Levy, H. 1932. The universe of science. – Watts and Co.
Lindeman, R. L. 1942. The trophic-dynamic aspect of ecology. – Ecology 23: 399–418.
Lotka, A. J. 1925. Elements of physical biology; reprinted in 1956 as 'Elements of mathematical biology'. Dover Publications.
McIntosh, R. P. 1985. The background of Ecology. – Cambridge Univ. Press.
Phillips, J. 1934. Succession, development, the climax, and the complex organism: an analysis of concepts, part I. – J. Ecol. 22: 554–571.
Phillips, J. 1935a. Succession, development, the climax, and the complex organism: an analysis of concepts, part II. – J. Ecol. 23: 210–246.
Phillips, J. 1935b. Succession, development, the climax, and the complex organism: an analysis of concepts, part III. – J. Ecol. 23: 489–508.
Schulte Fischedick, K. 2000. From survey to ecology: the role of the British Vegetation Committee, 1904–1913. – J. Hist. Biol. 33: 291–314.
Spencer, H. 1880. Principles of psychology, vol. 1. – Appleton and Co.
Spencer, H. 1898. Principles of biology, vol. 1. – Appleton and Co.
Tansley, A. G. 1920. The classification of vegetation and the concept of development. – J. Ecol. 8: 118–149.
Tansley, A. G. 1922. Elements of plant biology. George Allen & Unwin.
Tansley, A. G. 1925. The new psychology and its relation to life. – Allen & Unwin.
Tansley, A. G. 1935. The use and abuse of vegetational concepts and terms. – Ecology 16: 284–307.
Tansley, A. G. 1939. British ecology during the past quarter-century: the plant community and the ecosystem. – J. Ecol. 27: 513–534.
Tansley, A. G. 1952. Mind and life. An essay in simplification. – Allen & Unwin.
Tansley, A. G. 2002. The temporal genetic series as a means of approach to philosophy. Originally read before the 'Magdalen Philosophy Club' of Oxford University in 1932, prepared for publication by Peder Anker. – Ecosystems 5: 614–624.
Vermersch, P. 1999. Introspection as practice. – J. Consciousness Stud. 6: 17–42.
Wilkes, A. L. and Wade, N. J. 1997. Bain on neural networks. – Brain Cognition 33: 295–305.
Willis, A. J. 1997. The ecosystem: an evolving concept viewed historically. – Funct. Ecol. 11: 268–271.