Stud. Hist. Phil. Sci., Vol. 31, No. 2, pp. 231–248, 2000

ALEKSANDR BOGDANOV'S HISTORY, SOCIOLOGY AND PHILOSOPHY OF SCIENCE

Arran Gare

Introduction

With the failure of the Soviet Union, Aleksandr Bogdanov has come under increasing scrutiny as the anti-authoritarian, left-wing opponent of Lenin among the Bolsheviks and the main inspiration behind the *Proletk'ult* movement, the movement which attempted to create a new, proletarian culture (Sochor, 1988).[1] Bogdanov's efforts to create a new, universal science of organization, a precursor to systems theory and cybernetics, has also attracted considerable attention (Gorelik, 1980; Bello, 1985; Biggart et.al. 1998). And he has been recognized as an early environmentalist and as a feminist (Graham, 1984; Gare, 1994; Gare, 1996, pp.249-52). But few people have paid much attention to Bogdanov as an historian, sociologist and philosopher of science.[2] Yet Bogdanov developed highly original ideas on science, offering unique resolutions to the oppositions between instrumentalism and realism and between internalist and externalist accounts of scientific development, and following from these, proposed a radical transformation of science as the foundation for an equally radical transformation of society.

Bogdanov was a leading political figure who made original contributions to a number of disciplines. All facets of his work, including his political activity, were inter-related. While my concern here is with Bogdanov's work on science, this cannot be entirely abstracted from his socio-political context and his broader social philosophy. Furthermore, it is difficult not to be struck by the similarity between Bogdanov's ideas and ideas of later thinkers, and to fully understand Bogdanov from the vantage point of the present it is necessary to see where he concurred and where he deviated from them. While a full analysis of such relationships is beyond the scope of this paper, where called for I will indicate these similarities.

Who Was Bogdanov?

Aleksandr Aleksandrovich Bogdanov (1873-1928), the pseudonym of Aleksandr Malinovskii, was a leading Marxist revolutionary and a major intellectual figure in Russia in the first three decades of the century. As a founder of the Bolsheviks, Bogdanov was a rival to Lenin, particularly for the allegiance of left-wing Marxists. He opposed the authoritarian tendencies of Lenin, long before the October revolution - and then initially opposed this revolution, not because he ceased to be a socialist, but because he believed it would not be a genuinely socialist revolution. Given the culture of the Russian people, Bogdanov believed Soviet society would become either a capitalist economy run by a new class of authoritarian technocrats, or a form of war communism which would eventually lead to the enserfment of the workers and to economic stagnation. "Socialism is first and foremost a new type of co-operation: a comradely organization of production" Bogdanov wrote. "War communism is first and foremost a special type of social consumption and authoritarian, regulated organization of mass parasitism and destruction." (Bogdanov, 1918, p.87) He argued that "[b]ureaucratic regulation, [the organizational form of war communism], owing to its authoritarian character, tends towards stagnation in its methods." (ibid., p.84)[3]

After the revolution Bogdanov inspired a radical movement which worked towards the creation of a new proletarian culture in order to save the revolution, or rather, to pave the way for

---

[1] For a guide to the published and unpublished work by and on Bogdanov, see Biggart et. al. (1998). In 1990 an entire issue of The Russian Review (49, 3 (July)) was devoted to the question of whether Bogdanov did offer an alternative, anti-authoritarian path for the Soviet Union as Sochor claimed.

[2] The exception to this is Jensen (1978).

[3] How these prognostications related to Bogdanov's theory of organization, and the response to them at the time, is described by Plyutto (1998).

a genuine socialist revolution, a revolution in which the division between organizers and the organized, between mental and physical labour, would be overcome. This was the Proletkul't movement which, despite the attacks upon it by Lenin, inspired not only much of the Soviet Union's great art, literature and science of the 1920s, but also the Worker's Opposition, the group which attempted to democratize the factories (Sochor, 1988; Mally, 1990).[4]

Bogdanov wrote on economics,[5] sociology, knowledge, culture and organizations, and was the most original proponent of the effort to weld Marx's social theory with the "scientific philosophy" of neo-positivism - to thereby transcend the limitations of each (Jensen, 1978). His work on the sociology of knowledge and culture anticipated much of the work of later Western Marxists, while his general theory of organizations not only foreshadowed the development of cybernetics, general systems theory and praxiology, but combined these and went beyond anything achieved by the classic traditions of cybernetics and systems theory (Bogdanov, 1984a; Bogdanov, 1989; Bogdanov, 1996). With his concern for degrees of stability and instability, crises, radical transformations and the emergence of new levels of organization, he to some extent anticipated the ideas of René Thom, Ilya Prigogine and the complexity theorists; that is, what Simona Poustilnik has called the "second macroparadigm" of systems theory (Poustilnik, 1998).[6] He differed mainly in his attitude towards mathematics which he saw as having only a limited realm of applicability. It is relevant to the study of systems in which wholes are equal to and not more than the sum of their parts (Bogdanov, 1984a, p.46).

Bogdanov's Point of Departure

While Bogdanov was influenced by Marx, he was no orthodox Marxist. Bogdanov's initial philosophical and scientific orientation derived from the now little known work of Noiré, a German polymath who in the 1870s attempted to reformulate the ideas of classical German philosophy (Fichte, Schelling, Schiller and Hegel) in terms of current intellectual and scientific developments.[7] Aligning himself through Noiré with the same tradition of German philosophy from which Marx began his intellectual career, Bogdanov understood the interpenetration of philosophy and economics in Marx's work. Before the publication of Marx's earlier works, The 1844 Manuscripts, The German Ideology and the Grundrisse, Bogdanov fully appreciated Marx's central concern with alienation and fetishism and the commitment to creating an integrated community which would overcome the fragmentation of the human psyche. Citing the Theses on Feuerbach more than any other of Marx's works, Bogdanov characterized Marxist philosophy as "social materialism". He criticised the way Marx portrayed the division between the economic base and the superstructure on the grounds that the notion of the economic base was unclear and that this division did not do justice to what had been relegated to the superstructure. For instance, legal relations are an essential component of the relations of production. Bogdanov also argued that Marx's conception of technology was inconsistent and that Marx neither explained why every society needs ideology nor showed the relationship between ideology and the economy. Marxists "considered art to be a mere decoration of life, and the mathematical and natural sciences as pure and independent of social relations." (Bogdanov, 1996, p.97)

Following Noiré, Bogdanov also embraced and aligned himself with the German tradition of anti-mechanistic natural philosophy and science. He argued that revolutionary developments of the natural sciences raised serious questions which Marxists could not ignore. Marxist theory of social change needed to be brought into relation with biological theories of change and with the new scientific psychology. While Bogdanov strove to understand all the most recent

---

[4] Bogdanov not only anticipated Gramsci's ideas on culture, but probably influenced them, as Zenovia Sochor has pointed out (1981, p.60).

[5] Bogdanov's first book, A Short Course on Economic Science, initially published in 1897, went through fifteen editions and was still being published and used as a text for students in 1923 when Bogdanov was coming under increasing criticism.

[6] Poulstinik (1998) gives the clearest exposition of the relationship between tektology and complexity theorists. But see also Shapiro (1998) for an integrated use of tektology and complexity theory. For a general history of such ideas, excluding Bogdanov, see Webster and Goodwin (1996).

[7] This has been analysed in White (1998) drawing on Grille's biography of Bogdanov (Grille, 1966).

developments in the science of his time, the most important scientific influences on him were the Monists: Ernst Haeckel (1834-1919) - the biologist who founded the Monist League,[8] and his successor as the chief exponent of Monism and as head of the Monist League, Wilhelm Ostwald (1853-1932).[9] While Haeckel was the greatest exponent of Darwin's theory of evolution in Germany in the nineteenth century, like Noiré, he was more fundamentally influenced by the Naturphilosophen.[10] In particular Haeckel was influenced by Goethe, and referred to Lucretius, Bruno and Spinoza as sources of his opposition to the dualism between Spirit (or mind) and matter. He argued that they had all shown "the oneness of the cosmos, the indissociable connection between energy and matter ... mind and embodiment." (Haeckel, 1894, p.5) Ostwald, as Haeckel's successor, was the leader of an important group of scientists who were extending the ideas not only of Haeckel, but also of Ernst Mach, who had argued against atomism on the grounds that all untestable hypotheses should be eliminated from science. Science, argued Mach, should proceed by taking an intuitively plausible principle and then striving to harmonize all particular ideas with this principle. Ostwald argued that all observable phenomena should be reduced to the principle of energy, and he proposed the development of all scientific fields in terms of energetics (Elkana, 1974, p.265). At first only inanimate matter was to be reduced to this principle, then the phenomena of life were included, and finally from 1900 onwards Ostwald attempted to account for psychological phenomena as energetic processes.

In his first philosophical works Bogdanov tried, with modifications, to extend Ostwald's project of conceiving everything in terms of the transformation of energy.[11] As Bogdanov understood it, the conservation of energy is the same as the law of uniformity and continuity of natural processes: everything must issue from something else. Accordingly, the basic task of science is to study the interaction and succession of natural phenomena, and Bogdanov saw the energy theory of causation associated with this as one of the major innovations of nineteenth century science. Science is no longer concerned with cause and effect as distinct phenomena, but with the processes involved in causal sequences. Bogdanov represented human society as an integral part of nature, an energetic process itself subject to self-adjusting natural processes, and he formulated in terms of this scheme an interpretation of the historical succession of social systems.

However, Bogdanov was no reductionist. In this scheme, cognition was ascribed the central role. Taking knowledge as a sociological rather than an epistemological phenomenon, Bogdanov argued that the study of the inner dynamics of social relations is equivalent to the study of the development of knowledge. Reformulating Marx's social theory to avoid his defects (in a way which clearly anticipated Habermas) Bogdanov claimed that "[s]ocial existence and social consciousness in the exact meaning of these words are identical" (Bogdanov, 1904, pp.40-1), and that social consciousness has two levels, the technical and the organizational. Activity on external nature generates "technology", which for Bogdanov denoted not material equipment but the organization and utilization of knowledge related to external nature (Bogdanov, 1904-6, vol. 3, p.59). More complex technology requires more complex organizational forms. This is the realm of ideology, or what has been called in idealist philosophy, the realm of spirit - words, concepts, customs, laws, norms - all of those things which are called ideas in the broadest sense of the word. For instance, an "artistic idea serves as a living means of rallying the collective

---

[8] The extent of the influence of Haeckel on Bogdanov has been pointed out by Adams (1989, p.10f.).

[9] Alexander Vucinich (1976, ch.8; 1988, p.367f.) argues that Ostwald's energism was an enduring influence on all Bogdanov's work.

[10] For the source and structure of Haeckel's ideas and their importance for conservation, see Bramwell (1989, ch.3).

[11] It was not only the second book which was written under the influence of Ostwald, as Vucinich suggests. Bogdanov makes clear that Basic Principles was also written under Ostwald's influence in Empiriomonizm (vol. 3, p.xviin). This was pointed out by Ballestrem (1969, p.308 n.3.)

toward a unity of perception, feeling and mood; it rears an individual for his life in society, prepares the organizational elements of the collective and introduces them into its internal order", while "custom, law, morals and decorum - establish and regulate the relations among people in a collective and thus strengthen their connection." (Bogdanov, 1984a, p.3) Bogdanov was concerned to give due recognition to both technology and ideology in the advancement of society, and these were merged in the category "culture" (Bogdanov, 1904).[12] The central theme of Bogdanov's sociology was then the regularities in social change as recorded in cognitive culture.

Knowledge as the Organization of Experience

To develop this conception of society and this conception of culture required more attention to the nature of knowledge. Bogdanov turned to the empirio-criticism of Ernst Mach and Richard Avenarius, synthesizing their epistemological views with his modified Marxist theory of the labour process to formulate a new philosophy which he called "empiriomonism".[13]

Bogdanov embraced the empirio-critics' starting point, that what is real is experience, and that knowledge is a form of social adaptation aiming to orient people by providing a description of experience with the maximum economy of thought. He also accepted the empirio-critics doctrine that experience comprises things and mental representations - it is not to be equated with sensations in the minds of individuals. "A man of practice" wrote Bogdanov, "takes things as things, rather than as mental facts, and acknowledges that they are precisely as he sensually perceives them, and not a mystery, concealed somewhere 'in themselves' under the shell of phenomena." (1923, p.181) However, following Marx, that is, Marx understood as a philosopher of praxis rather than as a materialist, Bogdanov qualified this, arguing from "the labour point of view" or "the point of view of collective labour activity", that experience is the sum total of all human effort and resistance to that effort.[14] While the empirio-critics called for the analysis of experience into its component parts or elements to discover their bonds and relationships, Bogdanov argued that the components of experience are not a priori elements; there are many possible ways to divide experience into elements, some more useful than others. Elements are separated out to accord with the needs of production, they are the product of a certain amount and type of effort directed against a certain amount and type of resistance:

> They are the product of social effort in labour and thought; they are segregated out in dependence on practical demands, developing with the growth and complication of the system of labour. Experience as a whole and each of its elements is simultaneously ... resistance and ... activity. (Bogdanov, 1923, p.309)

Such activity is first physical and then mental. Matter, argued Bogdanov, is a mere abstraction, a metaphor designating that which resists labour. The objectivity of the physical does not have a basis in epistemology but has a sociological basis as the product and reflection of social-labour organization (Bogdanov, 1923, p.286ff; Jensen, 1978, p.130).

Developing this view, Bogdanov contested the empirio-critics denigration of explanation and defended the reality of causation. As Bogdanov interpreted them, the empirio-critics were opposed to the "substitution" of metaphysical constructs for experience; for instance atoms for observed phenomena such as heat flows or correlations between temperature, pressure and volume. The empirio-critics wanted to free science from such substitutions and reduce

---

[12] This development is described by Biggart, (1982 esp. p.4). Biggart argues that this could have been an indirect source of inspiration for the American school of "cultural materialists" (Leslie White, Julian Steward, Betty Meggars and Marvin Harris).

[13] This doctrine was first worked out in Bogdanov (1904-6), but was further developed and more succinctly stated in Bogdanov (1923). The latter work has been thoroughly analysed by Jensen (1978).

[14] Bogdanov's understanding of experience, both physical and psychical, is carefully analysed by Jensen (1978, ch. 4, esp. pages 126 & 128). Jensen shows how Bogdanov has generally been misunderstood on this crucial point.

knowledge to pure description of experience, which could be expressed in functional relationships between variables. For Bogdanov, description is a slave to experience; knowledge is the organization of experience, to form and fulfil it. While he was sympathetic to attacks on substitutions which had come to be taken as absolutes, he argued that all advances in knowledge are based on substitution - knowledge is organized by cognitive models through substitution. Substitution begins with language. 'Man substitutes words, ... the symbols of art, writing, etc., ... for various forms of consciousness, feeling, striving and thought." (Bogdanov, 1923, p.84) For instance the word "anger" is a substitute for certain gestures and facial expressions. Through substitution people can understand one another and can explain the sense of their actions. From this elemental level, substitution has been carried over to all other levels of experience "with an aim to accomplish their explanation, to give understanding and prediction", and to facilitate the control of nature (loc.cit.). The process of substitution involves "taking an object and effectively changing it into something else, while at the same time admitting the essential difference" (ibid., p.68). For example, to say that the sun is a star, or that it is a conglomeration of gases in space which behaves according to the laws of motion, is to substitute something for the sun as it is visually apprehended by people. One complex of elements of experience is replaced by another different from it. In general, advances in understanding are made by substituting for a simpler, less plastic complex with which relatively little may be done in practice or consciousness, a complex which is more subtle, more plastic and therefore more useful; hence the tendency towards mathematical models in science. Substitution is the basic method for bringing all experience into a unified whole. What is required is not the abolition of substitution but a readiness to substitute indefinitely, and a recognition of the practical and conscious activity involved in such organization of experience.

While granting a central role to substitutions, Bogdanov still held induction to be a major part of science. However he not only followed Mach's view that induction involves abstraction and imagination,[15] but offered an even more activist account, and in opposition to the empirio-critics, saw it as identifying causal processes. For Bogdanov, "induction, leading from particular facts to increasingly broader generalizations and eventually to universal ones, is represented by three basic forms: generalizing-descriptive, statistical and abstractly analytical." (Bogdanov, 1984a, p.55). By abstracting, that is, separating and removing complicating moments, the basic laws of phenomena (which are characterized through substitutions) are established; that is, the laws expressing their invariable tendencies. In the natural sciences this is usually carried out in real terms by experiment; however in the social sciences where the phenomena are too complex, this is usually only undertaken ideally or mentally.

It is the theory of substitution which provided the foundation for Bogdanov's sociology of knowledge. One of the problems raised by the theory of substitution is where do the "substitutes" come from. They are generated by the "dialectic of social labour". Bogdanov argued that workers who initially develop their separate perspectives through labour, come into conflict, which is intensified by the urge to complete a task. The conflict is resolved when one worker's perspective prevails over the other, or some third perspective is generated which is agreed upon. This "scheme of the dialectic, created in one realm of social experience, may then be applied beyond its limits to other realms of phenomena, social and extra-social." (Bogdanov, 1923, p.218) This is the law of "sociomorphism" (ibid., pp.290-293). Accordingly, Bogdanov claimed that "action precedes thought [which in turn,], seizes upon the forms of that action: the practical organization of labour effort precedes the mental organization of the elements of experience and produces it." (ibid., p.291f.) The cognitive models which are used as substitutes may originate in simple social-labour practice, in the methods of social-labour technique, or in the relations of production. Cognitive forms taken from the realm of social labour in this way, then reinforce the existing organization of social labour. Particular substitutes are taken as absolute, are fetishised and treated as idols, just as the institution of property is fetishised and idolized in capitalist society. For instance, Bogdanov argued that:

---

[15] On Mach's philosophy of science and conception of induction, see Feyerabend (1987, ch.7).

> ... the savage living in a commune which is organized on the basis of authoritarian leadership and passive submission, thinks, that is, organizes in his consciousness, of the entire universe in the same way: he thinks of the ruling "god" and the people and things subordinated to him; and he organizes them in his thought into the ruling, leading "soul" and the passive "body". (Bogdanov, 1984a, p.29)

Conceiving of the universe on the model of social life, fetishizing the authoritarian relationship which is being used as a substitute, legitimates such authoritarian leadership and makes it difficult to even conceive the possibility of organizing society in a different way. Similarly, Bogdanov argued that atomism "originated in ancient thought when individualism developed in society setting men apart. People were accustomed to think about themselves and others as isolated entities, and they transferred this habit onto notions about nature: in Greek, 'atom' means an 'individual,' and in Latin it means 'indivisibility'". (Bogdanov, 1984a, p.29) Atomism was then fetishised and used to legitimate such individualism.

In Philosophy of Living Experience, Bogdanov used this way of analysing the source of cognitive models to explain the history of materialist philosophy from the pre-Socratics to the materialists of the nineteenth century (Bogdanov, 1923, pp.86-125). He also explained the ideas of the empirio-critics, whom he noted were socialists, as the product of a new class within capitalist society between the bourgeoisie and the proletariat which had partially overcome the division between intellectual and manual labour, and by virtue of this had come to see the substitutions of past science as fetishes, just as they had come to recognize that property is a fetish (ibid., pp.204-211).[16]

Recent developments in science, themselves manifestations of a change in work and work relations, were thus seen to be already portents of the new socialist society. In societies with an authoritarian structure, such as ancient or feudal societies, cause is understood to predominate over effect as something strong and active. Regularities in the material world are seen as produced by spirit, by something transcending the world. With the development of capitalist society effect is understood abstractly as following cause out of some sort of natural or logical necessity, independent of human will and experience, reflecting the powerlessness of people before the impersonal imperatives of the market. With the development of more complex technology bringing a closer relationship between labour and the control of production, a new concept of causation has emerged within science. Machine production changes the world by changing the physical, chemical and electrical forces into one another as natural forces are changed into the mechanical forces of production. In essence, machine production is "the systematic transformation of efforts, or, in scientific and exact terms, the transformation of 'energy'" (ibid., p.268f.). Bogdanov rejected the "fetishistic" concept of energy as a thing in itself, and also the notion of it being a useful fiction; the first because it represents energy apart from labour activity, the second because it conceives energy only in relation to thought and not in relation to action. The concept of energy arises from the use of labour causality as a substitute, and it should be recognized as such. Energy represents the practical relationship of society to nature, of human activity to that which resists it. The transformation of energy refers to the creation and change wrought by active, human effort on resisting nature; "to see 'energy' in the processes of nature means to look at those processes from the perspective of their possible labour exploitation by man." (ibid., p.271f.) Since neither effort nor energy is either created or destroyed in production, but simply takes on different appearances and uses, cause and effect modelled on the transformation of energy must appear as equal, as simply "different phases in a continuous series of changing and changeable phenomena." (ibid., p.270)

This change foreshadows a situation where workers will cease to be mere labourers and will control production. What is required to bring this about, for labourers to become scientists able to appreciate all aspects of production, and simultaneously, what will emerge with the overcoming of specialization based on capitalist exchange relations, is a new science.

Tektology as a New Universal Science

---

[16] Bogdanov's analyses of materialism and empiriocriticism have been described by Jensen (1978, pp.50-66 and 81-86).

What is required is a more general science, a science which deals with the most universal aspects of organization, which thereby simplifies knowledge, enabling what has been learnt in one field of activity to be applied to any other field. Science needs to systematize the entire cognitive experience of the past. Bogdanov devoted most of the rest of his life to developing the foundations for this new science, producing what he regarded as his most important work, Tektology: The Universal Organizational Science (from the Greek word "tekton," meaning "builder"). Bogdanov described Tektology in his autobiography as "a general study of the forms and laws of the organization of all elements of nature, practice and thought." (Haupt and Marie, 1974, p.288)

While to begin with Bogdanov was concerned with social organization, Bogdanov believed that our organizational experience of labour activity could be used as a substitute for understanding the rest of nature, and argued that this provides the basis for a monistic world-view, allowing us to see ourselves as self-organizing participants within a self-organizing nature. Nature itself "is the first great organizer, and humans are only one of its organized products. The simplest living cells, which can be seen only with thousand-fold magnification, surpasses the complexity and perfection of its organization all that man can organize." (Bogdanov, 1984a, p.4) Even "inorganic" nature is organized. "Complete disorganization is a concept without meaning." (ibid., p.5) "The primary substance of the universe should be comprehended as a chaotic mass of elements of an infinitely low level of organization" Bogdanov wrote. "Non-organic matter with its intra- and inter-atomic energy represents a higher level. Here the organization of elements is already present, albeit in primitive, lower forms..." (Bogdanov, 1923, p.307). The entire universe is thus represented as a self-organizing totality. As Bogdanov wrote in the introduction to his Essays on Tektology:

> Thus, the experience and ideas of contemporary science lead us to the only integral, the only monistic understanding of the universe. It appears before us as an infinitely unfolding fabric of all types of forms and levels of organization ... All these forms, in their interlacement and mutual struggle, in their constant changes, create the universal organizational process, infinitely split in its parts, but continuous and unbroken in its whole. (1984a, p.6)

Tektology attempts to systematize the fragmented knowledge of organizational methods so they can be studied and developed to reveal structural relations and laws common to the most heterogeneous phenomena, to reveal the most general characteristics of organization. As he put it in Tektology:

> The aim of tektology is to systematize organizational experience ... Tektology should discover what modes of organization can be observed in nature and in human activity, then it should generalize and systematize these modes; further it should explain them, that is, elaborate abstract schemes of their tendencies and regularities; finally, based on these schemes it should determine the direction of development of organizational modes and show their role in the economy of the world process. (Bogdanov, 1989, vol.1, p.127; Bodganov, 1996, p.85 (translation modified))

To establish which modes of organization can be observed and to explain them it is necessary to examine elements and their combinations into complexes (or complex systems), where elements are understood as activities-resistances of all possible types (Bogdanov, 1996, p.72ff.). It should be noted, however, that elements cannot be identified absolutely but only relative to particular complexes; what is elemental from the perspective of one complex might itself be complex, and what from one point of view are activities will be from other points of view resistances. "Complexes" are combinations of elements with a particular structure able to resist the activities of other complexes. If a complex has greater effect against resistances than its elements, it is organized, if it achieves the same effect it is neutral, and if less, disorganized (Bogdanov, 1984a, ch.2). "A disorganized whole is practically less than the sum of its parts", wrote Bogdanov (ibid., p.43).

The formation, nature and fate of complexes are governed by formulating and regulating tektological mechanisms. (ibid., ch.3; Bogdanov, 1996, ch.3). The formulating tektological mechanisms, those which create or destroy a complex, are defined by the concepts "conjunction" (that is, the joining of complexes), "ingression" (the entering of common links between the

elements being joined), "linkage" (the entry of elements of one complex into another, for example, the common object of cooperatively organized efforts, or the merged parts of bacteria which belong to both bodies), "disingression" (the disintegration of conjugated systems to form separate complexes) and "boundary" (that which divides such complexes). There are various types of integration of complexes, but Bogdanov focussed on two in particular, "egression" and "degression" (ibid., ch.6). Egression involves a differentiation between degrees of interdependence and influence among systemic elements (for instance between managers and staff in a business organization, or the brain and other organs in a body). Degression involves a differentiation between a stable, but less plastic part and a plastic, but less stable part (for instance between a skeleton and flesh, or between the core ideas of an ideology and variations adapted to diverse circumstances (equivalent to the hard core of a scientific research program and its auxiliary hypotheses).

The problem which now arises, Bogdanov suggested, is "the fate of these formations - of their conservation, consolidation, dissemination or decline, destruction. This is the problem of tektological regulative mechanisms." (Bogdanov, 1996, p.174) At the base of the regulating mechanisms lie the processes of selection. There are three elements to selection: the object of selection, the agent or factor of selection and the basis of selection. Through selection, complexes assimilate and disassimilate elements from their environments, and are thus regulated by them. It is these regulative mechanisms which account for conservation, preservation, development, transformation and destruction of complexes.

The most basic form of selection, conservative selection, "concerns the preservation of forms or their non-preservation" (ibid., p.78). This is illustrated by Darwinian selection, where particular kinds of organism are selected by a biotic community. However, conservation is only one aspect of selection, and there is no question of pure conservation of forms. "Tektology deals only with activenesses, and they are always defined as producing change" Bogdanov wrote (1996, p.188). Conservation or preservation of forms is only possible through change. "Preservation is always only a result of the process where each of many changes are counter-balanced by equal and opposite changes; this is the dynamic equilibrium of change." (loc.cit.) As the form of a waterfall is constantly preserved in the process of the constant change of its water, the forms of tissues, organs and even skeletons of organisms are preserved in "the dynamic equilibrium of the material and energy exchange between organic and non-organic complexes and their environmental means." (loc.cit.) This is also true in the physical world. Bogdanov suggested that:

> With the progress of scientific research, all kinds of chemical stabilities are gradually reduced to an equilibrium of opposite exchange relations; and there are many reasons to believe that the same thing will happen in relation to the stability of electrons and the energy composition of atoms." (ibid., p.189)

Many of the regulators of these complexes are organized to preserve a particular state against environmental vicissitudes. Bogdanov distinguishes between simple external regulators, such as regulators of speed in a steam engine, and more complex dual regulators or "bi-regulators" which pervade complexes in dynamic equilibrium. He described these as "a combination in which two complexes mutually regulate each other." (Bogdanov, 1984a, p.164) There is no need for an external regulator because the complex regulates itself. Clearly this is another name for the modern cybernetic concept of feedback - although as formulated it is capable of much wider application. For instance, Bogdanov characterized in these terms "the familiar system of equilibrium 'water-ice' under 0^0 centigrade", writing: "If water is being heated above zero, then the contiguous ice takes away surplus heat, absorbing it during melting; if there is a cooling off, then a part of the water freezes up, freeing the heat which does not permit the temperature of ice to drop below zero." (loc.cit.)

Without the stable forms associated with dynamic equilibrium, knowledge in general would be unthinkable. But at the same time Bogdanov also argued that there is no pure stasis in nature; a complex which is not developing will eventually be destroyed by the activities-resistances of its environment. "[R]eal preservation of forms in nature is possible only through their progressive development, without which 'preservation' inescapably reduces to destruction, even if it is

imperceptible for the ordinary methods of investigation." (ibid., p.79 & 80) Complexes are developing or being destroyed according to whether there is a preponderance of assimilation over disassimilation - "positive progressive selection", or a preponderance of disassimilation over assimilation - "negative progressive selection" (ibid., p.82f.). In either case, changes are associated with changes in form, with growing instability, and finally with crises.

Stability and instability is central to tektology. Conceiving complexes as dynamic and continually interacting with and assimilating or disassimilating elements from their environments, stability is always only a matter of degree and needs to be explained. Stability is dependent "not only on the quantity of activities-resistances concentrated in it, but also on the mode of their coupling and the character of their organizational connections." (ibid., p.88) Structural stability, for example the resistance to bending or breaking, represents a magnitude which can be expressed quantitatively. When instability finally reaches a point of radical change, we have a crisis.

Characterizing form as "a totality of connections among elements", Bogdanov argued that "a change in form can only consist either in a destruction of any former connections or in the appearance of new connections, or in both." So, "the essence of crises lies in the formation or violation of complete disingressions." (ibid. p.232) Phase transitions, electrical discharges and a variety of chemical, biological and social changes were all characterized as crises in this sense, and Bogdanov argued that crises are ubiquitous in nature, society and the psyche. He distinguished between two kinds of crisis, "crisis C" (conjunctive crisis - associated with the conjoining of complexes) and "crisis D" (disjunctive crisis - associated with the disintegration of complexes) (ibid., p.241ff.).

Development, increasing instability and crisis are illustrated in a simple way by a dew drop:

> The drop grows in the air which is saturated with moisture [in which assimilation prevails over disassimilation], but with sufficiently precise observation it is easy to note that its form also changes; it becomes more and more flattened. ... If the progressive selection continues, the flattening of the ellipsoid is joined by a gradual stretching of the drop along the same axis; and the drop finally divides. The accumulated changes in its internal structure have led to a crisis. (ibid., p.83)

Here stability, instability and crisis are a simple function of the quantity of water. Stability and instability and subsequent transformations of a more complex kind are illustrated by the development of ideologies. Ideologies were characterized by Bogdanov as degressive complexes:

> [S]ymbols in general, and their main group, - words and concepts - in particular, perform a skeletal role for the socio-psychic content. ... Consequently, the nature of ideologies is generally degressive, skeletal, with all the related features ... So, beginning with the simplest example, the word not only secures the living content of experience, but also hampers the future development of experience by its conservatism. In science and philosophy, the customary but obsolete terminology is often a serious obstacle to progress, preventing the mastery of new material, and distorting the meaning of new facts which it cannot express fully and precisely. But this contradiction appears even more vividly in the development of more complicated complexes... (ibid., p.195)

Describing the Catholicism of Europe at the end of the Middle Ages in such terms, Bogdanov described how: "The new living content, bursting out of the framework of the old dogma, created new degressive forms for itself: along with the religious system of ideas and norms there were worked out scientific and philosophical ones." (loc.cit.)

Bogdanov argued that there is a tendency of initially similar complexes to diverge as initial changes are reinforced by the variety of the environment (with some counter-tendency generated by similar environments towards convergence). Divergent complexes then conjoin to form new complexes. But the degrees of separateness and connectedness of complexes generated in this way are quite varied. The joint effect of the tendency to divergence and to interconnectedness is that "differences grow, leading to increasingly more stable structural correlations." (ibid., p.128) That is, we have what has come to be called "co-evolution" (Orgurtsov, 1998). This was shown by Bogdanov to be involved in the differentiation of cells to form multi-celled organisms, the development of "psychics" and the development of "languages, science, law, ethics and,

generally, any complex cultural form." (Bogdanov, 1984a, p.129) It is also associated with the development of the whole sphere of life, the biosphere, as a single system of diverging forms, and the biosphere, hydrosphere and atmosphere as parts of an even wider system (Bogdanov, 1984a, p.130; Bogdanov, 1989, vol.2, p.17).

In this way, the various forms of selection were shown to constitute the entire dynamics of evolution of non-living and living phenomena on earth, including the dynamics of culture and the psyche, accounting for emergence, conservation, stability, development, divergence, instability, radical transformation and destruction of complexes and the integration of complexes at multiple levels to the biosphere and the bio- hydro- atmosphere of which the biosphere is part.

Bogdanov's Contribution to the History, Sociology and Philosophy of Science

I have only given a very brief overview of the diversity of ideas on science developed by Bogdanov. To evaluate these one could fruitfully contrast Bogdanov's ideas with those of more recent historians, sociologists and philosophers of science, including systems and complexity theorists. But as suggested earlier, what is more important is the relationship between all his ideas. My contention is that Bogdanov's most important achievement is to have provided a perspective from within which these diverse ideas can be integrated.

The criticism of empirio-critics for failing to recognize the importance of explanation, leading to the development of his theory of "substitution", and the socio-historical analysis of the development of knowledge utilizing the notion of "sociomorph", closely parallel work in the philosophy, sociology and history of science which developed in opposition to logical positivism - a philosophy strongly influenced by Mach and Avenarius. "Substitution" corresponds to the central place given to analogies or to metaphors by Thomas Kuhn, Rom Harré and Mary Hesse, while the theory of "sociomorphs" anticipates the ideas of Marxist historians of science such as Franz Borkenau, Edgar Zilsel, Sohn-Rehtel, Joseph Needham and Robert Young who have shown how social practices and relations and the forms of thinking generated by them have provided the core metaphors used by the sciences. However, while post-positivist philosophers of science such as Hesse and Marxist historians of science such as Young have been at loggerheads over whether developments in science should be understood in terms of internal criteria or explained by external factors, Bogdanov combined these two perspectives. Developments in society, in social labour organization, generating new forms of thought, are described by Bogdanov as the condition for the creative advance of science. Similarly, while Bogdanov's praxis oriented empiricist starting point appears to be close to an instrumentalist theory of knowledge, his views on abstraction, the role of experiments and the nature of scientific laws anticipate the realism of Harré and Madden, Bhaskar and the later Nancy Cartwright (although by conceiving causation as process rather than as the action of agents, Bogdanov provided a more original theory than these thinkers and avoided the problem of conceiving the relationship between agents and their actions).[17] This realism is also evident in Bogdanov's characterization of organisations of all kinds: natural, social and psychic.

Are all these positions: internal and external accounts of scientific developments, and instrumentalism and realism, actually reconciled in Bogdanov's work? What I wish to argue very briefly is that they are. To appreciate that this is so it is necessary to begin where Bogdanov concluded, his tektology conceived of as the science of the future, the science of a society within which the opposition between intellectual and manual labour has been overcome. Bogdanov appears to be a relativist. He argued "[t]he objectivity of physical experience is its social organization", implying its relativity to different kinds of social organization through history (Bogdanov, 1923, p.282). But Bogdanov was not a complete relativist. He characterized the superiority of the new science of tektology by casting in terms of it an historical narrative revealing and accounting for both the achievements and the limitations of past science. As Alasdair MacIntyre has argued, this is the way radical advances in science can be evaluated

[17] Bogdanov's notion of causation is close to the notion of "immanent causation" of causal processes elaborated and defended by Dorothy Emmett (1992, p.56ff.) and embraced by Gerry Webster and Brian Goodwin (1996, passim.).

without recourse to absolute criteria standing independent of all theories (MacIntyre, 1977).[18] However, Bogdanov did more than this. He also cast into an historical narrative the changing social conditions of knowledge and the source of the substitutions used in science, and evaluated the achievements and limitations of these also from the perspective of tektology. Through tektology, he sketched an evolutionary theory of knowledge, in which a place was given to both the social conditions of science and to normal and revolutionary science, in terms of which he was able to account for and justify tektology.

Such a narrative has dramatic implications. It implies that the limitations in the science of Bogdanov's own time were at least in part a manifestation of the limitations of the form of society scientists were living in, and conversely, that the existing social order was being maintained by the fetishized substitutions of such defective forms of knowledge. Bogdanov not only interpreted and evaluated the knowledge of his day in relation to past knowledge. Constructing his history of science involved projecting the direction science should take in the future. And since he saw science as indissociable from social conditions, he projected what social conditions would be needed to develop this new science - social conditions which he believed would also require this new science.

This new science would not only workers to be self-organizing; it would facilitate a deeper understanding of all past science and all past social forms. And it would provide a perspective from which not only human history would become intelligible, but also natural history. Once the divisions between intellectual and manual labour, the organizers and the organized have been overcome and people have come to experience themselves as self-organizing activity, they will be able to free themselves from the old fetishes and corresponding dualisms and appreciate that all of nature consists of self-organizing activities, and to appreciate the diversity and intrinsic significance of these.[19] So while the past of human history is made sense of on the assumption that all knowledge is oriented towards controlling nature, society and individual experience for human purposes, and all past knowledge is interpreted in terms of such labour activity (i.e. instrumentally), humans will be able to appreciate that they are merely one form of organizing activity among others (i.e. realistically). Science itself will be comprehensible as a development within and of nature. As Marx argued in a work unknown to Bogdanov, The 1844 Manuscripts:

> Communism is the riddle of history solved, and it knows itself to be this solution. ... [N]atural science will lose its abstractly material - or rather, its idealistic - tendency, and will become the basis of human science... Natural science will ... incorporate into itself the science of man, just as the science of man will incorporate into itself natural science: there will be one science. (Marx, 1964, p.135 & 143.)

Bogdanov's argument is not refuted by the failure of Soviet communism. Bogdanov did not believe that the realization of genuine communism is inevitable and he had already in 1918 analysed the principles of organization later implemented by Stalin and shown why it would fail (Bogdanov, 1918). From Bogdanov's perspective, the failure to overcome the division between the organizers and the organized and between intellectual and manual labour will continue to undermine efforts to fully understand the world. Recent developments in culture, what is called "postmodernity", only become fully intelligible from Bogdanov's perspective.[20] Postmodern culture is characterized by a more intense commodification of knowledge, increasing control over the direction of science by governments, bureaucrats, administrators and private enterprise and the reduction in status of science and scientists.[21] This is associated with the syndrome identified by Jameson (1991), the loss in the ability of people to understand themselves

---

[18] Using Galileo as an example, MacIntyre (1977) pointed out that Galileo's theory "for the first time, enables the work of all his predecessors to be evaluated by a common set of standards ... the history of medieval science can at last be cast into a coherent narrative." (p.459f.)

[19] On Bogdanov's defence of the intrinsic significance of all life forms, see Bogdanov (1984b), p.116ff.

[20] For a "Bogdanovite" analysis of postmodern culture, see Gare, (1995), ch.1.

[21] This development is best characterized by Dickson (1988).

historically, that is, to construct an historical narrative to comprehend the past and situate themselves in the present in relation to this. Correspondingly, the small number of brilliant and popular scientists who are struggling for a comprehensive understanding of the world and the place of humanity within it, are, like Bogdanov's own ideas, marginal to the scientific establishment. Mainstream science has come to be virtually identified with the development of technology, and this is now all that is expected of it by the general public who no longer even attempt to situate themselves in relation to the history of humanity and as part of the cosmos. On the basis of Bogdanov's sociology of culture, this is precisely what one would expect from a social order in which manual labour is more divorced from intellectual labour than ever, in which the division between organizers and the organized is widening, and people generally are losing control over their destinies. Bogdanov's sociology of culture also explains the prevailing lack of interest in his own work on science.