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AUTHOR Habicht, Manuela H.
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ABSTRACT

This review discusses the relationship between neuroscience and psychoanalysis and introduces a new scientific method called neuro-psychoanalysis, a combination of the two phenomena. A significant difference between the two is that psychoanalysis has not evolved scientifically since it has not developed objective methods for testing ideas that it had formulated earlier. In contrast, neuroscience includes a range of subsidiary disciplines, each having its own specific methods used to study different aspects of the nervous system. The review specifically discusses the neurodynamics of dreaming and provides evidence that dreams are motivated by certain phenomena. It reviews information on Broca's aphasia to demonstrate that not all brain-injured patients are alike. The review assists in explaining why patients with right-hemisphere lesions who have only access to the intact positive emotions of the left hemisphere often feel inappropriately positive about their condition, whereas depression is much more common in patients who have only access to the negative emotions generated by the intact right hemisphere. It concludes that both sciences can make a contribution to each other, and that the predictive gap between neural and psychoanalysis processes can best be narrowed through the development of a conciliatory framework. (Contains 30 references.) (JDM)

Linking Neuroscience and Psychoanalysis

Manuela H. Habicht

Abstract

The aim of the review is to discuss the relationship between neuroscience and psychoanalysis and the introduction of a new scientific method called neuro-psychoanalysis that seems to be a combination of the two existing ones. The most significant problem is that psychoanalysis has not evolved scientifically, which means that it has not developed objective methods for testing the exciting ideas it had formulated earlier. In contrast, neuroscience includes a wide range of subsidiary disciplines each of which has its own special methods that are used to study different aspects of the nervous system (e.g. neuroanatomy, neurophysiology, neuropsychology, and clinical neurology). The review covers the neurodynamics of dreaming and provides evidence that dreams are motivated phenomena, driven by our wishes and the dopaminergic mechanisms, the appetitive (i.e. libidinal) 'command system' of the brain (Panksepp, 1985, 1998). The review of patients with Broca's aphasia demonstrates no changes in personality, motivation or emotion and provides an indication that not all "brain-damaged" patients are alike. The review also demonstrates that the location of the neurological damage determines whether or not normal ego and superego functions are influenced. Among other findings the importance of the right cerebral hemisphere for negative emotions in contrast to the left cerebral hemisphere that is dominant for positive emotions is demonstrated. The review assists in explaining why patients with right-hemisphere lesions, who have only access to the intact positive emotions of the left hemisphere often feel inappropriately positive about their condition, whereas depression is much more common in patients who have only access to the negative emotions generated by the intact right hemisphere.

The review concludes that both sciences can make a contribution to each other and that the predictive gap between neural and psychoanalytic processes can be best narrowed through the development of a conciliatory framework (Panksepp, 1999).

1. Introduction

The aim of this paper is to explore the relationship between psychoanalysis and neuroscience and the introduction of a new scientific method called neuro-psychoanalysis that seems to be a combination of the two existing methods. Psychoanalysis is a young science and has revolutionized our understanding of mental life during the first half of the twentieth century. Mental health professionals were able to gain significant insights into unconscious mental processes, psychic determinism, infantile sexuality, and the irrationality of human motivation. When these advances are compared with the achievements of psychoanalysis during this time, it can be said that those are less impressive. There have been relatively few brilliant insights, with the exception of certain advances in child development (Shapiro & Emde, 1995; Shevrin, 1998; Kandel, 1999; Levin, 1998, Isenstadt, 1998).

The most significant problem is that psychoanalysis has not evolved scientifically, which means that it has not developed objective methods for testing the exciting ideas it had formulated earlier. In fact Solms & Kaplan-Solms (2000) pointed out that Freud abandoned the relative security of the neuroscientific methods that he had initially learned from his teachers and moved into a different approach to mental health science known as psychoanalysis. However that does not mean that psychoanalysis has historically not been scientific in its aim. It simply has failed over the years to submit its assumptions to testable experimentation. Initially psychoanalysts could and did make many useful and original contributions to our understanding of the mind simply by listening to patients. However, over three decades ago Kurt Eissler (1969) wrote that the decrease in momentum of psychoanalytic research is due not to subjective factors among the analysts, but rather to

historical facts of wider significance: the psychoanalytic situation has already given forth everything it contains. It is depleted with regard to research possibilities, at least as far as the possibility of new paradigms is concerned. In general, the lack of objective testing methods influenced its decline at the beginning of the twentieth century (Kandel, 1999). Most data gathered in psychoanalytic sessions are the analyst's subjective accounts of what he/she believe has happened. Apart from well known analysts the concerns of modern behavioural science for controlling experimenter bias by means of blind experiment have escaped the concerns of psychoanalysts (Luborsky & Luborsky, 1995; Dahl, 1974; Teller & Dahl, 1995).

Freud's transition from neuroscience to psychoanalysis was no accident. Between 1895 and 1900 Freud was confronted with the problem of how subjective awareness can be produced by some anatomical structures and physiological functions of the brain, when he exchanged laboratory methods for those of the clinic. Presenting problems such as aphasia and neuroses began to dominate Freud's scientific attention and led him to abandon neuroscientific methods for psychoanalysis.

At the turn of the century neuroscience had very little to offer dynamic psychology as it was attempting to localize psychological processes in discrete cortical regions. At the end of Freud's life he reiterated his belief that psychoanalysis should remain aloof from neuroscience until it is capable of accounting for the dynamics of psychological processes (Solms & Saling, 1986). After Freud's death Luria influenced by Jackson took serious note of Freud's objections and developed the modern science of dynamic neuropsychology (Luria, 1973). To survive as an intellectual force in medicine and in neuroscience, and indeed in society as a whole, psychoanalysis needs to adopt new methodologies, new

intellectual resources, and probably new institutional arrangements for carrying out its research.

The question that has to be raised today is whether the introduction of "neuro-psychoanalysis" or the "neurodynamic approach" is and/or will be beneficial to both disciplines, neuroscience and psychoanalysis. If psychoanalysis wants to rest on its past accomplishments, it has to remain a philosophy of the mind, and the psychoanalytic literature – from Freud to Hartmann to Erickson to Winnicott – must read as a modern philosophical or poetic text alongside Plato, Shakespeare, Kant, Schoppenhauer, Nietzsche and Proust (Lear, 1998). But if psychoanalysts want to be evolving, active contributors to an emerging science of mind, a closer relationship between these two disciplines would be beneficial.

A closer relationship probably accomplishes two goals for psychoanalysis, one conceptual and the other experimental. Cognitive neuroscience could provide a new foundation for the future growth of psychoanalysis from a conceptual point of view. On the other hand biological insights could serve as a stimulus for research, for testing specific ideas about how the mind works (Kandel, 1999). Therefore we can probably agree with a sentiment expressed by Lear (1998) in which he stated that Freud has died after having lived an extraordinary productive and creative life and that it is important not to get stuck on him, like a rigid symptom, either to idolize him or to denigrate him. We cannot effort have psychoanalysis and neuroscience framed rigidly, but have to be open to the contributions that one discipline can make to the other.

2. Neuroscience and Psychoanalysis

Neuroscience includes a wide range of subsidiary disciplines. Each of these has its own special methods, which are used to study different aspects of the nervous system (e.g. neuroanatomy, neurophysiology, neuropsychology, and clinical neurology). It is argued that the appropriate point of contact between psychoanalysis and neuroscience is the discipline of neuropsychology (Solms & Kaplan-Solms, 2000). The dynamic tradition within neuropsychology deals with the nervous system from the viewpoint of its functional organization, using psychological methods. Its aim is to lay bare the neurological representation of human mental functions. After having identified the fundamental component parts of the functional system supporting a complex mental function using the method of dynamic localization, one has in fact established a gateway – a conceptual bridge – between psychological and neurological science. This allows the analyst to shift seamlessly between psychoanalytical concepts and their neurophysical correlates, form the global level of neurodynamic organization right down to the minutiae of molecular biology.

The first significant breakthrough in this area came in 1953, when Aserinsky & Kleitman discovered a physiological state, the rapid eye movement (REM) state that was the external manifestation of the subjective dream state.

2.1. The Neurodynamics of Dreaming

In 1962 after some initial research on animals, Jouvet stated that REM was produced in a small region of cells in the part of the brain known as the *pons*. A model proposed by McCarley and Hobson (1975, 1977) called the *reciprocal interaction and activation-synthesis model* proposed that REM sleep and dreaming were literally 'switched on' by a small group of cells within the pons, which excrete a chemical called 'acetylcholine'. Acetylcholine activates higher parts of the brain that start to generate conscious images. After a few minutes another group of cells within the pons will excrete noradreanaline and serotonin which 'switch off" the cholinergic activation and therefore in theory the conscious experience of dreaming. The above notion rested almost exclusively on the observation that REM state yielded dream reports on 70-95% of awakenings, whereas non-REM awakenings yielded such reports in only 5-10% of attempts.

However Solms & Kaplan-Solms (2000) pointed out that a second body of evidence gradually began to emerge, which led some neuroscientists recognize that perhaps REM sleep was not the physiological equivalent of dreaming after all. Non-REM dream reports including those during the sleep onset phase could not be explained using the initial assumption (Vogel, Barrowclough & Giesler, 1972). Kondo, Antrobus & Fein (1989) also discovered that non-REM dreams appear with increasing length and frequency towards the end of the sleep. Despite the strong correlation between dreaming and REM sleep, it is no longer accepted that dreaming is caused exclusively by the REM state.

The hypothesis that two separate mechanisms exist – one for REM and one for dreaming - could be tested by a method known as clinico-anatomical correlation. However since it involved the removal of parts of the brain that obliterate REM sleep it cannot be performed

on humans and the only source of information is from patients who have suffered spontaneous illnesses or traumatic brain injuries. Feldman (1971) reported that in 26 cases with damage to the pons patients have lost REM sleep, but only one has reported loss of dreaming. Other patients with damage to a different part of the brain reported a loss of dreaming but no disturbance of REM sleep. This allowed the conclusion that the parts of the brain that are crucial for REM sleep are in the pons and those crucial for dreaming are in the deep white matter of the frontal lobes of the brain, just above the eyes (Solms, 1997). If the large fibre-pathway that is contained in the frontal lobes is stimulated and dopamine is transmitted a massive increase in the frequency and vividness of dreams is noticeable without any effect on REM sleep. This means that dreaming can be switched on or off by a neurochemical pathway whose main function is to "instigate goal-seeking behaviors and an organism's appetitive interaction with the world" (Panksepp, 1985, p. 273). This means that neuroscience has contributed to the evidence of a radical hypothesis that is more than 100 years old i.e. that dreams are motivated phenomena, driven by our wishes and the dopamigergic mechanisms, the appetitive (i.e. libidinal) 'command system' of the brain (Panksepp, 1985, 1998). However patients with traumatic brain injuries have not only assisted us in gaining insight into the "ordinary functions of life" like dreaming but have also contributed to our understanding of clinical symptoms such as aphasia following impairment of other parts of the brain.

2.2. Neuro-Psychoanalysis and Aphasia

The contribution that neuroscience can make to the analytic work with patients can be best demonstrated when looking at a patient with significant neurocognitive impairment – namely, loss of capacity to express himself in language. The patient who was described as suffering Broca's aphasia experienced no changes in personality, motivation or emotion and was undergoing a process of normal mourning. This clearly demonstrates that not all "brain-damaged" patients are alike and that it depends on the location of the neurological damage as to whether or not normal ego and superego functions are influenced. This leaves us with the assumption that different parts of the brain serve different mental functions. The patient who was described by Solms & Kaplan-Solms (2000) as *Mr J* was offered a course in psychoanalytic psychotherapy that was slightly modified. The patient's acceptance of the psychoanalytic situation, the content of the communication and his desire to overcome communication difficulties revealed intactness of his ego functions. The therapeutic alliance appeared to be only disrupted by transference resistance as it occurs in non-neurological cases. In this case it will become clearer that psychoanalysis can also make a contribution to neuroscience. Solms & Kaplan-Solms (2000) pointed out that neuropsychiatric literature often states that patients with left-hemispheric lesions suffer depression whereas right-hemispheric lesions are indifferent to their predicament. This patient suffered damage to the left inferior lateral frontal region (Broca's area), but he was not clinically speaking, depressed. He was undergoing a process of normal mourning, which would not be possible in the absence of normal ego and superego functions. It could be assumed that the presence of those functions is in contrast to the widespread view within psychoanalysis to equate ego functions with verbally mediated thinking, a thought that has

its origins in Freud's distinction between "word-presentations" and "thing-presentations" . However Freud already recognized in 1891 that there are four primary modalities for language that produce "the word": visual, auditory, kineasthetic, and motor. Since each of these elements has different cerebral representations and the motor element of speech, according to Freud was not a component of language that subserved the important ego and superego function, they are left fundamentally intact. However if the auditory component of the speech apparatus is impaired the relationship with consciousness is disrupted (Freud, 1891).

2.3. Right Perisylvian Damage

There are a number of cognitive and emotional symptoms that are associated with this part of the brain and are known under the term "right-hemisphere syndrome". The symptoms fall into three categories known as anosognoisa (unawareness of deficit) or in more subtle forms known as anosodiaphoria (assume an emotionally indifferent attitude about the disability), and neglect (ignoring the left-hand side of space, and disorders of spatial perception and cognition). In addition to these symptoms classifications three additional theories of normal right-hemisphere functioning have been proposed to account specifically for those symptoms within the above categories that are not adequately explained by the purely spatial theories.

Attention arousal is for example connected to the right cerebral hemisphere (Heilman & van der Abell, 1980). The attention arousal loop includes right frontal, anterior limbic, thalamic, and core brain structures and privileges the right cerebral hemisphere with regards to the arousal and spatial distribution of attention. This results in both spatial hemispheric fields being under the purview of the right hemisphere, whereas the left hemisphere only attends to the right-hand side of space. When the left hemisphere is damages the right hemisphere can still maintain full attentional focus in both spatial fields, whereas vice versa that is not possible. However some complex phenomena that occur in a psychoanalytic setting can still not be explained in full.

Another theory focuses on the importance of right cerebral hemisphere for negative emotions in contrast to the left cerebral hemisphere that is dominant for positive emotions. This assists in explaining why a patient with right-hemisphere lesions who has only access to the intact positive emotions of the left hemisphere often feels inappropriately positive

about his/her condition whereas depression is much more common in patients who have only access to the negative emotions generated by the intact right hemisphere. This explanation sounds very simple, but the reader has to be assured that it a very serious and respectable theory in contemporary neuropsychiatry (Solms & Kaplan-Solms, 2000).

The third theory is associated with the name Damasio (1994). It focuses on James-Lange's theory of emotions. This theory states that emotions are perceptions of the current state of one's own body. Damasio also suggests that the right cerebral hemisphere is dominant for the perceptual representation of the body, and monitors the current somatic and visceral state. According to Damasio damage in this area will result "in an inordinate reliance on "as if" emotions, based on the *premorbid* state of the body" (Solms & Kaplan-Solms, 2000, p. 155). However most of these theoretical assumptions do not go very far beyond directly observable data. Caution is necessary in assuming that mental disorders are as simple as these theories. Most analysts know that this is not the case and that fundamental mechanisms underlying these disorders are not manifest in the directly observable phenomena. Once the underlying mechanism is exposed the psychological basis of the problem is often the opposite of what it appears to be. The underlying mechanism is called repression and manifests itself in resistance (Ramachadran ,1994, p.323).

Ramachandran (1994) demonstrated the phenomena of repression in a case of right perisylvian damage by pouring cold water into the left ear of a patient with neglect. The neglect disappeared completely, until the effect of the caloric stimulation wore off, at which point the neglect reappeared again. Ramachandran (1994) interpreted this as a temporary, artificial correction of the attentional imbalance between the hemispheres. It was interesting to notice that the patient also revised her memory of the distressing fact that

she had previously consciously acknowledged under the influence of the caloric stimulation – namely that her left arm was paralyzed. This phenomenon widely known in psychoanalysis as *resistance* was demonstrated by Ramachandran who at the time had no connection to psychoanalysis. If we believe in the idea that the mechanism of repression underlies - or least contributes to – the manifest clinical symptoms of anosognosia and that at some deeper level those patients do indeed have knowledge about their paralysed limbs, one has to reject Damasio's theory to the effect that these patients lack perceptual information about their current state of their bodies. However Solms & Kaplan (2000) have shown in numerous cases in *Clinical Studies in Neuro-Psychoanalysis* that right hemisphere patients with neglect and agnosognosia are far from being unaware of or indifferent to their tragic situations. After having engaged in a small amount of analytic work depression often surfaces. They explain the onset of depression with a failure of the process of mourning that is observed in left hemisphere patients. Instead these patients institute massive defensive measures which are designed to protect them against the awareness of the loss.

Solms & Kaplan-Solms (2000) describe "a regression in the libidinal cathexis of the lost object from the level of object love to that of narcissism" (p. 185) as the underlying factor for the defenses. They suggest that the right perisylvian convexity is a vehicle for whole-object cathexes. The destruction of this vehicle means the loss of the ability to bind our fundamentally ambivalent attitudes towards the real world. A regression from love object to narcissism can often occur when right perisylvian damage undermines the means by which we normally transform infantile narcissistic libido into mature and realistic object love. This is the emotional factor that distinguishes the right hemisphere syndrome from

damage to the left hemisphere where objects are represented not concretely but rather symbolically, as words rather than things. In support of the psychoanalytic view the theory of narcissism provides a link between these emotional aspects and spatial aspect of right-hemisphere functioning. "It reminds us that all our relationships with the external world are at bottom, driven by libidinal needs, which are rooted in our evolutionary constitution" (Solms & Kaplan-Solms, 2000, p. 198).

2.4. The New Neuro-psychoanalytic Model

The model that has been introduced by Kaplan-Solms & Solms (2000) is based on psychoanalytic investigations of 35 patients with localized cerebral lesions. It was pointed out that it might have to be adapted as testing of their hypotheses progressed. The framework of the new model attempts to integrate classical metapsychological concepts of Sigmund Freud as well as the dynamic neuropsychological model of Aleksandr Romanovich Luria by providing a relationship between brain and mind. Most of the research described in earlier parts of this paper has shown that we are now able to show the relationship between the psychic consequence of conscious and unconscious mental events on the one hand as well as the material sequence of physical brain events on the other. That means that we are able to correlate what we know about the mental apparatus from both of the terminal points (psychoanalysis and neuroscience) in our knowledge of it.

The beginning of the ego is seen at the point where sensory end-organs convey coded information derived from the outside world to the cortex (Kaplan-Solms & Solms, 2000). They point out that the information is analyzed and synthesized on its way to the unimodal cortical zones. This analysis or synthesis happens within the gray matter of the spinal cord,

the cranial nerve nuclei in the brain stem, and the modality-specific parts of the thalamus – the anatominal structures that roughly correspond to the system *Pcpt (Perceptual Conscious System)* of the mental apparatus from which the ego is originally derived. Protective and probably genetically predetermined barriers against stimuli can be found in the peripheral perceptual apparatus. The mnemic systems of the ego begin where the unimodal cortical zones merge into the heteromodal cortical zones. The mnemic system re-registers and re-transcribes external perceptual information in "directories" (Mesulam, 1998). The structuralization of the ego occurs on a deeper level. It includes the encoding of significant pattern that also act as stimulus barriers. In the right hemisphere as pointed out in the chapter 2.3. they correspond roughly to "whole object" representations. In the left cerebral hemisphere those primarily concrete visuospational representations are associated with abstract quasi-spatial presentations of an audioverbal type. Here we can see what is described by both Freud and Luria as the process of symbolization - the establishment of connections between "things" and "words".

The prefrontal cortical region is seen as the dynamic and economic epicentre of the ego (Kaplan-Solms & Solms, 2000). Anatomically the entire cortico-thalamic region coincides anatomically with the ego. It separates or mediates between external and internal worlds through the use of barriers between sensorimotor surfaces. On the outer surface of the cortex we find the unimodal perceptual and motor zones. This is were the ego begins. It terminates in the ring of the limbic cortex which surrounds the brain's interior. The barriers interpose memory between impulse and action, and they subserve attention, judgement, and thinking.

The epicentre of the id is in the vital grey structures that surround the fourth ventricle. The id that extends its influence rostrally, via the ascending system is regulated by the hypothalamus which reacts to the vital needs of the body via the autonomic and the endocrine system. "The id influences and is influenced by reality indirectly, through mediation of its ego, which it developed with experience from outer cortical layers" (Kaplan-Solms & Solms, 2000, p. 282).

The ventromesial regions of the prefrontal lobe, where the prefrontal lobe merges into the limbic system, are closely bound to the functions of the superego. This zone in particular represents the deepest stimulus barrier that the ego has at its disposal. The superego protects the ego from the incessant demands of instinctual life. The ego and superego can be dsecribed as a set of menmic sytems. They act as a series of stimulus barriers and occupy the region between the perceptual systems at one end and the instinctual drives at the other. On the latter side these barriers merge with the superego.

Research has also given us some indication that the libido and especially its narrowly sexual components is accessible to chemical means of analysis. However it has been pointed out that in order to answer the question of neurochemical evidence of sexual pleasure it is necessary to subcategorize it into pre- and postorgasmic phases. Panksepp (1998) mentioned further that in order to achieve a closer linkage between neuroscience and analysis more animal studies have to be conducted. However brain oxytocin as well as vasopressin circuits are seen among a list of others as candidates for organizing the behaviour and the emotions associated with sexuality.

3. Discussion

As we have seen, neuroscience could help psychoanalysis in two ways: conceptually and experimentally. We are in fact already beginning to see signs of conceptual progress. A number of psychoanalytic institutes, or at least a number of people within psychoanalysis, have struggled to make psychoanalysis more rigorous and to align it more closely with neuroscience. Freud argued for this position at the beginning of his career. More recently, Mortimer Ostow of the *Neuroscience Project of the Psychoanalytic Institute* and David Olds and Arnold Copper at the Columbia Institute, as well as many more in the U.S. have expressed similar ideas to those raised by the subject *Current Issues in Psychoanalysis.*

For many years both the Association for Psychoanalytic Medicine at Columbia and the New York Psychoanalytic Institute have instituted neuropsychoanalytic centres that address interests common to psychoanalysis and neuroscience including consciousness, unconscious processing, autobiographical memory, dreaming, and the etiology and treatment of mental illness. The attempts made by Karen Kaplan-Solms and Mark Solms (2000) to delineate anatomical systems in the brain that are relevant to psychoanalysis by studying alterations in the mental functioning of patients with brain lesions are probably the most commendable ones.

Kaplan-Solms & Solms (2000) believe that the power of psychoanalysis derives from its ability to investigate mental processes from a subjective perspective. However, as they point out, this very strength is also its great weakness. Subjective phenomena do not really lend themselves to objective empirical analysis. This would not really be a problem if the number of patients had not steadily decreased by 10% a year over the last 20 years (Jeffrey, 1998). This decline in the use of psychoanalytic therapy might be attributable to causes

outside of psychoanalysis: the proliferation of different forms of short-term therapy, the emergence of psychotherapy, and the economic impact of managed care. The failure of psychoanalysis to provide objective evidence that it is effective as a therapy might be another reason. However one of the most important reasons for its decline could be that psychoanalysis never attempted to identify the various brain structures, the dynamic functional systems of concertedly working neural zones, that are involved in a particular psychological process (Solms & Saling, 1986).

Some scientists have believed that we will never be able to understand the nature of subjective evidence since the "explanatory gap" is simply too large (Panksepp, 1999). However it is important to note that the "predictive gap" has diminished markedly as our base of neuroscience knowledge has grown. Following Luria's "neurodynamic approach" this review has shown that neuroscience can assist in the identification of the brain systems involved in the various ego functions. It has already started to investigate the emotional functions of the brain in general, but was limited to its rigorous conceptual framework. On the other hand psychoanalysis can probably contribute to investigations of personality changes and emotional disturbances that so often afflict brain-injured patients. Freud hoped for psychoanalysis and neuroscience to be rejoined, but also pointed out that this would not be possible until neurological knowledge could account for the dynamic nature of mental life (Solms & Saling, 1986). It can be seen that the predictive gap between neural and psychoanalytic processes narrows through the development of a conciliatory framework (Panksepp, 1999). "The explanatory gap" will be less intimidating than it used to be and it becomes more and more important to generate predictions in all modes of thought that can be supported or disconfirmed by well accepted scientifically proven

methods. The challenge for psychoanalysis is whether it can refresh Freudian theory, "which now has an unpalatable and distinctly post-Victorian flavor for many" (Panksepp, 1999, p.35). If psychoanalysis moves towards a modern and dynamic mode of thought that continues to be rejuvenated by the accumulating evidence in neuroscience it will more likely have a future in the twenty-first century.

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Organization/Address: 5 Goodman Court, Toowoomba QLD 4350, Australia	Telephone: +61 412330281	Fax: +61 7 33022392
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