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The implications of cortical laterality for childrens' reading difficulties

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DYSLEXIA: TOWARDS DIAGNOSIS

A STUDY OF THE IMPLICATIONS OF CORTICAL LATERALITY FOR CHILDREN'S READING DIFFICULTIES

THESIS
SUBMITTED FOR THE DEGREE

DOCTOR OF PHILOSOPHY

by

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Dedication

To my mother, Elizabeth Clark-Brandriff, who taught responsibility in learning,and to my son, Christopher Scott, who awakened compassion in teaching.

SUMMARY

Dyslexia as a concept is defined and reviewed in a context of psychological, neurological and educational processes. In the present investigation these processes are recognised but emphasis is placed on dyslexia as a phenomenon of a written language system.

The type of script system involved in the phenomenon is that of an alphabetic code representing phonological elements of language in script form related to meaning. The nature of this system is viewed in the light of current linguistic and psycholinguistic studies. These studies based as they are on an analysis of underlying written language structures provide a framework for examining the arbitrary and rule-governed system which a young child is expected to acquire. There appear to be fundamental implications for reading, spelling and writing processes; for example an alphabetic system requires recognition of consistent script-phonetic relationships, 'mediated word identification' and in particular uni-directional sensory and motor modes of perceiving. These are critical maturational factors in the young learner.

The skills needed by the child for decoding and encoding such a phonemic script are described in a psychological and neuropsychological framework. Evidence for individual differences in these skills is noted and the category of the dyslexic-type learner emerges. Incidence is related to the probabilities of individual differences in lateralisation of brain function not favouring the acquisition of our script system in some cases. Dyslexia is therefore regarded as a primary difficulty consequent upon the incompatibility between the written language system itself and the intrinsic, developmental skills of an individual's perceptual/motor system. It is recognised that secondary stresses e.g. socio-cultural deprivation, low intellectual potential or emotional trauma can further inhibit the learning process.

Symptomatology of a dyslexic syndrome is described.

The symptomology is seen by the writer to constitute a clinical entity, a specific category of learning difficulty for which predictive and diagnostic procedure could be devised for classroom use. Consequently an index of relevant test items has been compiled, based upon key clinical experiences and theoretical writings. This instrument known as theAston Index is presented and discussed. The early stages of validation are reported and the proposed longtitudinal studies are described. The aim is to give teachers in the classroom the power and understanding to plan more effectively the earliest stages of teaching and learning; in particular to provide the means of matching the nature of the skill to be acquired with the underlying developmental patterns of each individual learner.

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I pay special tribute to Mavis Fletcher who by her unique ability to decipher my hand-written scripts and type them, created 'cosmos from chaos'.

To Charles, for his understanding and tolerance of my 'mission' during the last ten years I give unending gratitude.

P R E F A C E

"Lassen Sie das Phänomen für sich selbst sprechen"

JOHN

John was referred to the Clinic as a poor reader when he was nine years old. His written work was marked by reversals, mirror-image writing, omissions, random use of capital letters; no punctuation and bizarre spellings. His parents were both professional workers - father was a University lecturer in mechanical engineering and mother taught design at the local College of Art. He had a sister eighteen months younger who was doing well at school, except that spelling was still difficult for her. She was left-handed. An older brother was at a grammar-technical school doing well in science and technical drawing, but finding modern languages and fluent written expression quite difficult.

There had been no apparent pregnancy or birth difficulties and milestones had been well within the normal range. Spoken language, however, was late in developing and John was nearly three years before he started to speak at all fluently. Parents noticed his early ability in spatial/manual tasks such as jigsaws and formboards. John seemed curious, lively and intelligent, and in fact when tested at the Clinic was found to be in the superior range of ability with oral/receptive vocabulary three years in advance of his chronological age. Reading and spelling and written expression however were three years retarded. When assessed in psycholinguistic skills, some difficulties were noted in visual sequential memory, and more severe problems in auditory sequential memory. Sound blending also presented some difficulties.

John had an inconsistent laterality pattern, e.g. he wrote and cut with his right hand, but dealt cards, threaded a needle, threw a ball and screwed a lid with his left. He had not established complete eye-dominance, but favoured his left eye in binocular viewing. He was also left-eared. The family pattern of laterality was also mixed:

father was ambi-dextrous and right-eyed; whereas mother was right-handed but left-eyed. There was a high incidence of left-handedness in both families. Father had been slow in learning to read but at nine years had made sudden progress and won a place at Grammar School. Mother attended Art School, but was poor at spelling and written fluency. In both maternal and paternal families there was a high incidence of professional engineering or design skills. The paternal grandfather was a doctor.

Recently it had been noticed that some secondary emotional difficulties were interacting with John's reading problems and he was withdrawing from any involvement in school activities. At home he was quiet and often near to tears. His attitude to his sister was growing increasingly sullen and defensive. He was regarded at school as fairly slow-learning, yet his intelligence as assessed by individual tests of ability was in the superior range.

DAVID

David was fourteen years of age and attended an ESN school in an industrial part of the city. He was referred to the Dyslexia Clinic by an experienced, perceptive teacher at the beginning of the school year when he entered her class. She had noticed three features of his behaviour which to her were not compatible with the general assessment of 'very slow learning'. She found that first he had a lively sense of humour and that he responded quickly to amusing situations and anecdotes which were often of a complex or subtle nature. Secondly, he was visiting local scrap-yards and collecting the remnants of old bicycles. He was re-assembling these in a most skilled way and had already sold a number of completed models. Thirdly, he was a very able and intelligent footballer and captained the successful school team.

Psycho-metric assessment revealed that he had a reading age of six and a half years and no spelling nor writing attainment which was measurable. However, he had a receptive vocabulary level of thirteen years and an overall intelligence level as measured by test of 88 per cent - within the average range of the population. This was considered an under-estimate of his real ability as he had apparently not experienced a level of thinking from his peer group which could have extended his

own reasoning powers or his general information level. His laterality pattern was ambi-lateral. Performance on the grapho-motor test was symmetrical for both hands. Both feet were equally skilled. He was more left-eyed than right and there appeared no difference in ear laterality between right and left.

He could not recite well-known sequences in correct order e.g. the months of the year and could not repeat digit strings of five forward or four in reverse. His scores on visual and auditory sequencing tasks were very low.

Father was a semi-skilled worker, but was good at carpentry in the home. Another brother had been unsuccessful at school but was now a successful hairdresser. He was ambi-dextrous. David had three cousins who were "left-handed" and had not done well at school but who were now succeeding in adult life. At the time of referral, with eighteen months of school-time left, hardly any skill at all in written language and regarded as a far less able person than he really was David's future looked bleak. But for the intervention of his perceptive teacher he would have become a 'disabled school leaver'.

MICHAEL

Michael was not rescued by any perceptive teacher. He was referred to the Clinic from a psychiatric hospital where at the age of twenty-nine he had been admitted after a complete breakdown at work. He was a shop-floor engineer and had been promoted to foreman because of his practical ability. As a result he would now spend fifty per cent of his time in an office and fifty per cent on the shop-floor. On the first morning in his new role he went into his office and found a desk full of letters to read, orders to write and decisions to make in written form. He surveyed this scene, left the office and returned home where he went immediately to bed. His wife returned home in the evening to find him there. He declared that he would never work again and almost cheerfully added that he would also remain in bed for the rest of his life.

Subsequently psychiatric examination revealed that he believed he could not read, nor spell and that he had been able to conceal this for most of the time by adopting intelligent strategies to meet each situation. Now his secret was known. He had been labelled a 'dunce' at school and had left believing that he must in fact be defective in some way. Father was a skilled shop-floor engineer but had been late in learning to read and spell. He was able to find employment for Michael in the firm. He was found to be able and skilled in the mechanics of his job and quick to learn the expertise required of him. He had joined the scouts where he became a responsible leader and was a lively member of his Church group.

Assessment at the dyslexia clinic revealed that his intelligence was in the superior range but that his reading was about nine years (he was surprised to learn that he had acquired this level of ability) and his written work and spelling were below this. He was ambi-lateral in the use of his hands and was left-eye dominant. He found both auditory and visual sequencing difficult and had difficulty in always distinguishing left and right directions in space if asked to verbalise the tasks. He was a good navigator however, when actually walking or driving over the terrain. Repeating a string of digits in reverse was very difficult for him. His performance on a grapho-motor test was perfectly symmetrical; left hand mirrored right hand.

Apart from the precipitating factor of his promotion, other anxieties were affecting his family life. He refused to have children because of his own most unhappy experiences at school. This decision was causing his wife great unhappiness. During a year's support from the clinic staff, he was able to leave the Hospital, be taken off drugs, resume his job, be placed again on the substitute-foreman's list, plan for a family and resume the outwardly cheerful, organised and friendly life he had managed to make for himself before the precipitating crisis.

Underlying this readjustment was his increasing powers in written language skills.With minimal 'props' and his own daily efforts he achieved a reading age of fourteen, a spelling age of twelve and a creditable style in written fluency. He would probably have been ready to do this at eight years of age if help and understanding had been available.

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C O N T E N T S

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DYSLEXIA: DEFINING THE CONCEPT

1.1 DYSLEXIA: DEFINING THE CONCEPT

The term dyslexia can be translated from the original Greek as: 'disability in learning the lexicon, the written word'.
The World Federation of Neurology (1968) defines the condition as:

'A language disorder in children, who despite conventional classroom experience, fail to attain language skills of reading, writing and spelling commensurate with their intellectual abilities'.

In educational practice, the difficulty is seen as failure to acquire adequate competence in reading, spelling, written fluency and sometimes a confusion in the patterning of spoken language. These difficulties can occur despite normal school experiences, socio-economic opportunity, emotional stability and adequate intelligence. Although stresses in the latter four areas can produce secondary causes of learning failure, the writer postulates the existence of a primary category of difficulty in learning a written language form which is often exacerbated by the extrinsic, environmental stresses. Throughout the present thesis, this category will be referred to as 'dyslexia' or dyslexic-type language difficulties. The purpose of the thesis is first to identify the category and to study in depth and breadth the nature of such a phenomenon; and secondly to develop within the context of developmental and educational psychology an appropriate instrument of early diagnosis.

The writer agrees with Klasen (1972) when she writes:

"Nearly a hundred years of research have done nothing to diminish the significance of the phenomenon called specific dyslexia."

Dyslexia appears to occur in all places where universal literacy is sought by the use of a sequential, alphabetic symbol-system of written language. The problem of recognising such a category of primary learning difficulty has become especially acute in English speaking countries during the last decade. There are, on the one hand, the theorists in medicine, neurology, psychology and education who, looking at different aspects of the problem, fail to agree on a common identity and indeed some educationists would deny that any specificity of identity can be attached at all to

failure in acquiring language skills; on the other hand there are the generations of beginner-learners who, arbitrarily directed into formal systems of education which are based upon competence in written language, fail to acquire this fundamental skill.

The incidence of illiteracy is reported from many sources as at least fifteen per cent of the school population. This figure is regarded by the writer as a conservative estimate and does not include children of good intelligence who are under-functioning. But, nevertheless, a problem of some magnitude is recognised. Goldberg (1972) quotes estimates of twenty to forty per cent of reading failure in school population. Wherein, therefore, lies the confusion of aetiology of identity? A recent letter in the Times (1 December 1973) by Alfred Morris MP highlights the dilemma. He writes:

"So far the department's (DES) only solution for these problems is the erasure of the word dyslexia from the language. Even to mention dyslexia to the DES excites a Pavlovian response. It automatically replies with the same, very selective quotations from the report by Professor Tizard[1]. Yet the Department of Employment freely uses the word. Earlier this week, Mr Dudley Smith, Parliamentary Under-Secretary of State for Employment, said in an oral parliamentary answer ....he had no doubt that dyslexia exists." (Hansard, 27 November 1973)

To understand the present position of controversy, it is necessary to look at the various conflicting theories and to trace the origins of these in the writing and researches of the different authorities.

1.2 HISTORY OF THE CONCEPT

Dyslexia as a concept has been known for at least a hundred years, since Adolph Kussmaul, a German Internist, in 1877 translated the neurological-psychiatric term 'alexia' as 'word-blindness'. The disorder was generally distinguished as a special type of speech disorder or aphasia, caused by injuries to the left or dominant

1. 'Children with Specific Reading Difficulties'. Report of the Advisory Committee on Handicapped Children. HMSO 1972.

hemisphere of the brain for speech. 'Dyslexia' was first used as an alternative to 'word-blindness' by Professor Berlin of Stuttgart in 1887 and in 1892. Professor Déjerine of Paris (1892) examined the brains of some patients with 'dyslexia' and found that:

"there always existed a lesion far back in the posterior temporal region in the left cerebral hemisphere where the parietal and occipital lobes come into contiguity".

From 1895 however, James Hinshelwood, a Glasgow eye-surgeon, published in the Lancet, and in the British Medical Journal, a series of articles describing a similar disorder, but not apparently caused by brain injury. He later summarised these articles in a book entitled "Congenital Word-Blindness" (1917). In this book he defined word-blindness as:

"a congenital defect occuring in children with otherwise normal and undamaged brains, characterised by a disability in learning to read so great that it is manifestly due to a pathological condition and where the attempts to teach the child by ordinary methods have failed".

Hinshelwood did not postulate any organic defect of the brain but felt that the condition resulted from a failure to develop the brain function associated with visual memory of words, letters or figures - mentioning in particular the angular gyrus region of the brain. General intelligence and the 'power of observation and reasoning' were found to be normal or above normal. The disability seemed to occur more frequently in boys than in girls, was often hereditary and often improved as the child matured. Hinshelwood considered that auditory memory was commonly unaffected but in 1921 Fildes reported that dyslexia was characterised by defects in both auditory and visual discrimination - mentioning difficulties with recognition, perception, orientation and reproduction of written material. Hinshelwood's reports were supported by two other medical authorities at this time: Dr Pringle Morgan, a general practitioner in Seaford, described a paradoxical case he had seen of an intelligent boy of fourteen years who was incapable of learning to read, and James Kerr, Medical Officer of Health to the City of Bradford, in an essay "School Hygiene, in its mental, moral and physical aspects" (1897) described special reading difficulties in children of normal intelligence.

1.3 LATERALITY, SEQUENCING AND NEUROLOGICAL DOMINANCE ASPECTS OF DYSLEXIA

Specific features in the performance of persons affected by the dyslexia problem began to be noticed. Faulty orientation of written symbols was especially noted by Orton (1937). He first proposed the idea that there is a disturbed directional sense underlying dyslexia, starting from the observation that there appeared to be a striking tendency for dyslexic children to show a reversal in right-left (and sometimes up-down) orientation in reading and writing letters and words - for example 'b' for 'd', 'saw' for 'was' - and even to show complete mirror reversals. He described this phenomenon as 'looking at random' and 'the failure to acquire series'. Orton made a close study of these retarded readers, who had been referred to his clinic in Iowa. He discovered certain common phenomena apart from the reversal and orientation problems. These included left-handedness or ambi-dexterity, or signs of conflicting handedness and eyedness. He postulated that the perception of letters and words set up a series of patterns or 'engrams' implanted in the brain - those in the right hemisphere being mirror images of those normally orientated ones in the left hemisphere as in right-handed persons. But in the left-handed and ambidextrous person the left hemisphere has failed to establish its normal dominance over the right; the result being that such people tend to use the reversed engrams of the right hemisphere instead of the normal ones of the left. Orton believed that behind all these phenomena there lay a physiological state of ambiguous occipital dominance; a faulty patterning of brain function. For this condition, which constituted a kind of graded series, Orton proposed the term "strephosymbolia" (twisted symbols).[1]

Since 1937, other researchers into the phenomenon have described the tendencies to reversal and directional confusion first noted by Orton and related by him to incomplete cerebral dominance. Vernon (1957) expounding the theory of delayed maturation, included

1 Other terms used to define specific reading difficulty are: congenital-alexia; legasthenia (according to Klasen 1972), currently used in German speaking countries); word-amblyopia; typho-lexia; amnesia visualis verbalis; analphabetia partialis; [illegible] and print-blindness.

left-handedness and ambi-dexterity as concomitants of reading disability. Naidoo (1961) considered that sequencing disability was one of the few factors common to all dyslexics. She felt that the disability involved "processes of perception, retention, recall and rapid production in an exact sequential order". Money (1962) reported that reversals and translocations of letters are common among all beginners in reading and writing, but that they persist in the dyslexic:

"The dyslexic child is not unique in making reversals and translocations, but he is unique in making so many of them and for so long a time".

In 1964 Ingram, in a seminal paper 'The Dyslexic Child' examined the nature of the difficulty and used the term dyslexia specifically in relation to features of order and orientation of letters and words and synthesis of sounds, syllables and words. Benton, McCann and Larsen (1965) examined 250 children with reading difficulties and found the following figures:-

93 had crossed dominance - 82 being left-eyed/right-handed; 11 being right-eyed/left-handed; 36 were ambi-dextrous; 17 had no eye-dominance; 104 had incomplete dominance.

Lückert (1966) emphasised that eye, hand and foot preferences only become significant in the causation of reading difficulty if they are crossed ie. thus indicating a functional disorder. Bryden (1970) found that a significantly higher proportion of boys with speech and motor functions oppositely lateralised were poor readers, than those showing the normal crossed pattern. Klasen (1972) writes that crossed dominance appears to be a more frequent and significant factor than left-handedness in dyslexia and sensory mechanism laterality. Critchley (1964) writes:

"To a clinical neurologist certain functions are recalled which are commonly regarded as being parieto-occipital in character. The not infrequent conjunction of dyslexia with directional disorders and with spatial defects both of a personal and extra-personal nature may be cited as telling evidence. In so far as symbolic thinking is at fault, it is the parieto-occipital region of the dominant hemisphere which is under suspicion, that is if one can discern cerebral dominance at all in these dyslexic patients".

Especially interesting is the Jasper-Raney Phi-Test which by comparing illusory movement of objects within the two homonymous fields claims to gauge occipital lobe dominance. Using this test Ettlinger and Jackson (1955) found that dyslexics display no clear cut directional preponderance. This suggests a lack of one-sided occipital dominance which may well be the evidence of non-maturation. This state, often spoken of as cerebral ambi-laterality is believed by some to be associated with an unstable cerebral organisation, one which is particularly sensitive to the effect of stress.

The most widely held view among neurologists today is that both cerebral ambi-laterality and dyslexia are to be equated with immaturity of cerebral development. Gooddy and Reinhold (1961) who have entertained the same notions of maturational lag have expressed them in somewhat different terms. They stressed the hypothesis that in normal circumstances asymmetry of the functions of the two cerebral hemispheres is established during child development and that this asymmetry of function is closely related to the performance of reading and writing. Children with developmental dyslexia, however, fail to establish asymmetry of function in the cerebral hemispheres.

Drew (1956) sought to invoke a basic defect in Gestalt recognition. The spatial defects, reversals in reading and in writing, mixed hand/eye preferences, and other defects which may be met with in dyslexics, are according to him variant manifestations in the fundamental defect in correct figure/ground recognition. Drew believed that the inconsistencies, confusion and apparently diametrically opposed findings reported in the literature and observed clinically can best be resolved by interpreting the findings in a configurational setting.

Vernon (1957) writes regarding the EEG findings on laterality:

"Raney concluded that lateral dominance was a localised specific function of a given area, rather than a completely unilateralised gradient of the whole hemisphere".

But he suggested that in general the 'central excitatory state' and the peripheral nerve sensitivity of the dominant side of the cortex

were greater than those of the non-dominant side since the alpha rhythm was less. A study by Lindsley (1940) indicated that cross-laterals showed less synchronisation of alpha rhythms between the two hemispheres than predominant right or left sided individuals. Cohn (1949) reporting on the clinical neurological findings and writing problems writes:

"The EEG's in the patient group showed abnormalities in over fifty per cent. The abnormalities consisted of relatively high voltage slow waves (around 4 - 5 per second) predominantly over the homologous occipital derivations and of generalised paroxysmal electric activity. In the control group only ten per cent showed similar abnormal electric output."

Vernon (1957) writes:

"It is possible that there are other differences of the EEG's of the two hemispheres which relate to laterality but at present the evidence is not at all clear or definite".

To conclude this appraisal of neurological factors and to include some of the most recent hypotheses in the field of reading disability there follows a passage from a paper by Bannatyne (1960). In discussing the high male to female ratio (possibly ten to one) amongst dyslexics, he states:

"One of the most important characteristics of dyslexia is difference in sex incidence. In severe cases the ratio may rise to ten to one and so there seems to be little doubt that genetic dyslexia is in some way a sex linked characteristic. Dyslexic boys in this genetic group do quite well in all those spatial tests which do not demand sequencing and their visual perception in terms of relationships in three-dimensional space is usually good. Their ability to conceptualise logically in terms of meaning is also usually quite competent. The main area in which they fail is in terms of linguistic or other types of automatic coding fluency. In fact arbitrary (that is 'non-logical') sequencing tests are especially difficult and in essence learning to read and spell are nothing more than arbitrary, irregular sequencing processes which in the average person rapidly become automatic with some training".

Bannatyne postulates that a good appreciation of spatial relationships demands a fairly well co-ordinated motor system involving both hemispheres of the brain and acute three-dimensional vision in both visual fields. This calls for the equal use of the visual areas of the

brain in both/

hemispheres. This neurological state of affairs ie. the equality between the hemispheres, in people with a reasonable or high degree of spatial ability tends to make them ambi-dextrous and to make them scan the whole field of vision very rapidly in all directions as is necessary in a three-dimensional world. Reading calls for a discipline of scanning in one direction only. An appreciation of space in terms of survival value, particularly in terms of vision demands peripheral stimuli to be rapidly recognised and interpreted in both the left and right visual fields and hence in both the right and left visual areas of the brain. Moreover, probably the two hemispheres work in terms of mirrored sensory and motor functions. Most external bodily functions particularly those involving the motor and visual areas require mirrored neurological impressions because one side of the body surface is very much a mirror image of the other. Since men have learned to read this ancient requirement for other purposes has been a slight handicap. Reading demands training the eyes to move in one dimension, in one visual field. Therefore the right visual field is dominantly involved (in European languages). This means that almost all the visual information during the reading process is fed into the left occipital lobe from which it is probably internally transferred in its mirror image to the right occipital lobe. But in visuo-spatial people with hemispheres having an equality of dominance, these transferred mirror images (letters) in the right visual field can be fed out when writing or reading almost as easily as the correct ones in the left visual field. As both are almost equally associated with a particular sound either one can be fed out in response to that sound. The muddle is increased when the mirror image of the one letter is also the primary image of yet another letter-sound combination. Therefore the visual letters b and d and the phonemes for b and d become a four way tangle. Mirror-imaging and the post lateralisation of eye movements in one dimension is probably caused by a superior spatial ability which itself results from a relatively superior development of the visual and motor cortices. Good visuo-spatial ability demands an equality of hemispheric dominance even though in most people there seems to be some kind of control centre in the right hemisphere. Verbal auditory abilities, by contrast, seem to demand a strong dominance of one hemisphere, usually the left

for their successful and rapid processing. Using the right visual field for reading and the right hand for writing means that almost all linguistic material will be processed in the left hemisphere of the brain and within that hemisphere there will be an economy of neurological communication. During linguistic activities the right hemisphere in people with good verbal ability can thus be suppressed in terms of most interference, be it visual, motor or auditory.

Newton (1968 and 1973) found a significant incidence of ill-lateralised motor and sensory-mechanism patterns in children presenting with difficulties in reading, spelling and written fluency. It will be shown in a later section (Chapter 4) how present day neurologists and psychologists are relating specificity of brain-laterality function to the acquisition of linguistic skills.

Shankweiler and Liberman (1972) suggest:

"that it will be worthwhile to look closely at disparity in lateralisation.....not only.....of speech and motor function, but also of dominance for the perception of written language, and very likely with an emphasis on the relationships between them.....If reliable techniques suitable for use with children can be developed for studying lateralisation of component processes in reading, we suspect that much more can be learned about reading acquisition in relation to functional asymmetry of the brain".

1.4 MATERNAL AND NATAL FACTORS IN AETIOLOGY

Difficulties in child learning, especially in symbolic learning, are often attributed to central nervous system damage sustained in pre, peri or post-natal situations. When children are referred for special education or to school psychological services, special attention is paid in clinical case histories to such predisposing factors. Fisher (1910) for instance suggested that birth injury could be a predisposing cause of dyslexia. Kawi and Pasamanick (1959) undertook a comprehensive study to test the hypothesis that some of the reading disorders in childhood may be consequent to minimal cerebral injury following abnormalities of the pre-natal and perinatal periods. The authors

postulated a "continuum of reproductive casualty" extending all the way from death in utero and in the neo-natal period to minimal cerebral damage resulting in minor behavioural dysfunction; reading disorders constitute a component of this continuum. They found that in 16.6 per cent of a series of two hundred and five children with reading retardation, there had been complications during the mothers' pregnancies (pre-eclampsia, bleeding or hypertension). They also suggested that asphyxia and prematurity were aetiological factors in the incidence of cerebral damage leading to reading retardation.

Reitan (1964) quotes a personal communication from Doehring. Doehring made a study of the differences between thirty-nine retarded readers and thirty normal readers, including physical and neurological examinations. Evidence of brain damage was found in fifty-six per cent of the retarded readers as against five per cent of the normals and Doehring suggests that impaired brain function may frequently be a significant factor of reading retardation. Reitan (1964) states that among the consequences of brain lesions (probably acquired at or before birth) are: a loss in general adaptive abilities, which is manifested by learning deficits and inability to sustain concentrated attention and motivation; a loss in the ability to form and generalise rational concepts; and deficits in the perception and manipulation of visuo-spatial configurations.

Buchanan (1968) describes how cell divisions of the neurons of the cerebral cortex is complete by the fifth foetal month, and at that early time in life the number and quality of these important cells is permanently determined. Any neurons that are destroyed by injury or disease are not replaced by other neurons. Injured neurons are removed by the microglia, which engulf them and carry them to the nearest venous system. Their place is filled by astrocytes and astrocytic fibres. Buchanan makes the interesting observation that it may seem strange that the neuron, the most important cell in the body cannot be replaced, but, if replacement were possible, memory could not exist and language and learned actions would have to be relearned every few months.

Critchley (1968) makes the distinction between a genetic form of dyslexia which is constitutional, organic, pure and specific in nature and which can be described as primary reading retardation; and a form he describes as "symptomatic dyslexia". This latter form relates to a history of perinatal trauma, foetal infection, foetal damage or anoxia. As such, it could be the expression of minor brain damage and may include mild spastic condition or some hyperkinetic disorder. A person with genetically determined dyslexia may also have a history of pre, peri or post-natal trauma, but this would be considered by some researchers, including the writer, as a coincidental element in the case.

De Hirsch, Jansky and Langford (1966) report that prematurely born children start life with a neuro-physiological lag, still present and not fully compensated by the time they are expected to learn to read and write. They base their prediction on a study of fifty-three prematurely born subjects, matched for intelligence range and socio-economic opportunity with fifty-three children from the general population Their theory was derived from clinical experiences over twenty years and they postulate that learning to read requires the developmental timing of both neurophysiological and psychological aspects of readiness.

Crosby (1968), also from many years of clinical practice, postulates that a large proportion of dyslexic children, very early in infancy:

"had a problem, perhaps minimal brain dysfunction, on one side of the brain, resulting in a shift of handedness."

Although this theory as stated appears somewhat speculative, it does relate to the work of other writers in the field of lateral dysfunction in the brain, notably that of Annett (1965)

Prechtl (1962) described a distinct neurological syndrome associated with dyslexia in a group of fifty hyperkinetic children from nine to twlve years old. All had characteristic choreiform movements. A majority also had disturbances of conjugate movement of the eyes,

hyperactive reflexes and defective right-left discrimination. A significantly high percentage of the case histories showed complications of pregnancy and neonatal disturbances. Prechtl felt that these children belonged to a different group of so-called dyslexic subjects than those in which the hereditary aspect of reading disability was stressed.

Whitsell (1967) reports that cases of

"primary reading retardation in his clinic have fallen into three aetiological categories:

i)	Hereditary:	family history of similar language or learning problems
ii)	Acquired:	history of pre-natal, peri-natal or infantile illness and injury without obvious residual neurological deficit
iii)	Combined:	hereditary and acquired defects."

The writer finds a high frequency of birth trauma in the clinical records of children referred to her for dyslexic-type difficulties. These include hyper-tension or toxaemia in pregnancy; rhesus negative mothers (second or third baby); premature or over-term births; pregnancy bleeding; extended birth time; difficulties in first breathing and in sucking; abnormal crying patterns; mis-shapen head at birth; use of instruments at birth; breach presentations etc. In several cases a mother has reported prophylaxis against virus infection (e.g. rubella) in about the third month of pregnancy. In addition to showing the developmental perceptual anomalies of reversal, mirror imaging, disabilities in visual auditory sequencing and directional confusion in motor mechanisms, these cases can also present problems of attention, hyperkinesis, some spasticity, variability of performance and memory deficit. Such recurring events in clinical studies of dyslexia lead the writer to favour the above theories of coincidental causation.

As will be discussed again in the chapter on "Barriers to Learning" the probability exists that any one individual child could enter school at the age of five years both with instrinsic constraints to written-language learning (and these could be hereditary or acquired) and inhibiting environmental factors.

Wepman (1962) points out

"that dyslexia may be due to a number of factors and in many instances may have multiple causation".

It is the aim of this thesis to examine and separate these underlying fundamentals, and then to focus attention on one primary aetiology - that of an "interface" between the nature of an alphabetic written language and the developmental brain organisation of the young learner. This review of maternal and natal factors in aetiology seeks to clarify the issue in regard to some of the neurological factors and the next section considers neuro-psychological findings and theories related to the dyslexia phenomenon.

1.5 NEURO-PSYCHOLOGICAL FACTORS

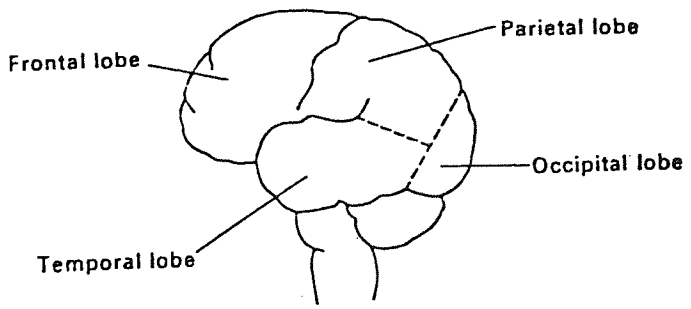
Bannatyne (1966) includes under the heading "minimal neurological dysfunction" only those children whose brains are abnormal in the sense that they are qualitatively dissimilar by reason of unusable cells or malformed areas which are not found in the normal population. Children whose brains are malformed or damaged even when the reason is genetic are included. He claims that different kinds of lesions can cause similar symptoms just as widely differing symptoms can result from apparently similar lesions. He thinks that this may be because some brain areas are specifically developed and programmed by the environment and training in infancy and early childhood, differences in individual experiences influencing later performance. The modifying influences of early environment are especially acknowledged by such development psychologists as Hebb (1966), Piaget (1952) and Bruner (1964). Individual potential, they claim, whether from genetic endowment or inhibiting cerebral trauma can be either brought to full effective working power or allowed to atrophy by early nurturing environment. The writer constantly observes the effect of previous home and school environments on children referred for dyslexic-type difficulties. Some clinical reports give favourable prognosis for future written language competence due to understanding, supportive parents and perceptive, insightful

schools; others need to recommend urgent attention to the provision of a much more propitious background for a child and attribute some of the present failure to lack of opportunity and understanding. But she also agrees with Bannatyne (1971) who writes as a neuro-psychologist and who seeks to promote understanding of the dyslexia phenomenon by considering both intrinsic and extrinsic features.

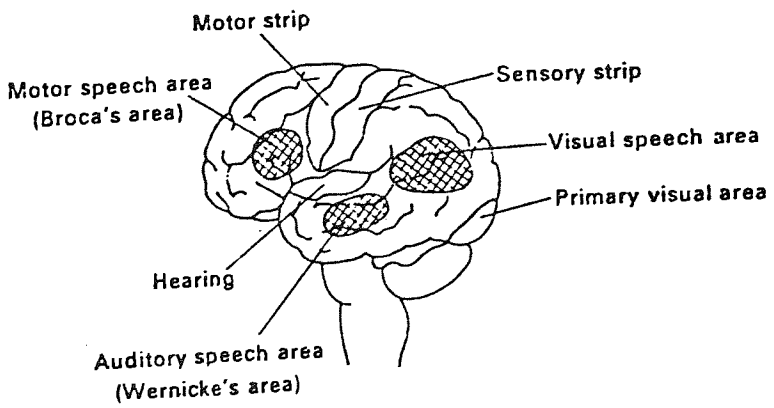
This chapter of the thesis is specifically concerned with the relationship between language behaviour and intrinsic factors; events which occur in the neurological organisation of the brain itself. Linguistic ability is a function of this organ in that man's brain co-ordinates speech activities through the ability to plan and structure the vocal sounds in advance of their actual production (Gurney, 1973). The brain-language-speech association can be represented simply as in the following diagrams:

DIAGRAM 1

7 Lobes of brain (left side)



8 Speech areas of brain



(Reproduced from Gurney, 1973)

The brain is divided into two major hemispheres and each hemisphere into four lobes. All the lobes are important in speech processes since any sensory impulse may make connection with the speech association areas.

It can be seen that there are three major speech areas in the fore-brain. These occur in the association area of one hemisphere usually the left (this will be discussed more fully later in the text). Each speech area in the cortex is associated with the primary areas for motor activities, hearing and vision. On the sensory side of speech, auditory impulses from the ear are relayed to a portion of the temporal lobe during its perception. In close connection is the auditory speech or Wernicke's area. Damage in this region results in sensory or receptive aphasia - an inability to understand the spoken word. Visual impulses are projected to the occipital region of the cortex which has an associated region mediating reading and writing. These activities are impaired when this region is damaged (Gurney 1973). In the frontal lobe is Broca's area, referred to in an earlier section and one of the earliest references to functional areas of the brain specific to language. This area is associated with the motor strip controlling body movements. Damage in this region affects speech and causes motor or expressive aphasia. On the motor side of speech there are a number of cortical areas concerned with movement and the sensory feedback from sense organs in the muscles and joints affected by movement. The motor system can both initiate and check on speech therefore.

The sensory strip and its related area in the parietal lobe receives and interprets body stimuli from muscle movements, pressure and touch, which in turn can be relayed to the speech association areas. Gurney (1973) postulates that the parietal lobe may be important for starting and continuing speech; also helping with 'internal speech', particularly the recall of names. Parietal lobe structures, as well as those of the frontal lobe (Broca's area) seem to be involved in formulating and elaborating speech as well as being involved in the more abstract conceptual aspects of language.

There is also a region in the parietal lobe where three association areas overlap. This 'parasensory overlap' (Gurney 1973) could facilitate the interconnections between association areas and make possible stable associations from different sense organs. It may also be associated with the development of cerebral dominance, (Geschwind, 1965).

Returning to Bannatyne's category of "minimal neurological dysfunction", it can be seen from the above brief description of brain organisation for language mechanisms that the development of language behaviour depends upon a complex integrity of structure and function for realisation of its full power.

Many researchers have focussed attention on a possible relationship between cerebral dysfunction and dyslexia. Kussmaul (1878), Broadbent (1896), Kerr and Morgan (1900) all stressed the concept that reading disability resulted from a specific focal cerebral lesion usually considered of angular and supramarginal gyrus location. Head (1926) also postulated the relationship of brain damage to reading disability and Weisenburg and McBride (1935) concluded from their studies that local brain injury could disturb the use of language. Orton (1937) considered that the locus of an area of brain destruction is of much greater importance in determining a language disorder than the amount of tissue damaged. He wrote:

"while no area of the brain can be designated as the centre for reading because of the complexity of the symptoms, we can nevertheless nominate an area in the dominant hemisphere whose integrity is essential to maintaining a normal reading skill and the critical area for this fraction of the language function is the angular gyrus and its immediate environs".

Lesèvre (1964) in an EEG study comparing dyslexic children with normal readers, investigated the oculo-motor patterns observed during reading and non-reading visual tests. She found that the dyslexics with this oculo-motor inefficiency are only whose who also show disturbances of the spatial function and suggests that dyslexia originates in the cortical regions. She found non-functioning or immaturity of the

regions on which depend integration of functions, such as the handling of spatial data, visual-spatial perception or the recognition of body image. The lesions which give rise to oculo-motor or vestibular disturbances were localised at the level of the parieto-tempero-occipital junction.

In a study by Spiel (1953), two boys with reading difficulty showed poor development of the parieto-occipital rhythm in their EEG recordings and McFie (1952) reported unusual or borderline features in the EEG's of four cases of reading difficulty.

Cohn (1961) made a detailed neurological study as part of an intensive interdisciplinary survey of forty-six children selected from a country school system because of difficulties in learning to read and write. He found a high incidence of time disorientation, right-left disorientation, simultanagnosia, reflex abnormalities, impaired motor co-ordination and mechanical speech disturbances. A similar pattern was described by Rabinovitch, Drew, De Jong, Ingram and Withey (1954) as characteristic of primary reading retardation: right-left confusion, various extinction or inattention phenomena, cortical sensory disturbances, mixed hand-eye preferences, non-specific motor awkwardness and dissociated dysgraphia and speech and spelling abnormalities, in various combinations with the reading problem. A majority of the children in Cohn's (1961) study had abnormal EEG patterns. He felt that the reading difficulties in this group were not "isolated phenomena dependent on a specific lesion, but the result of a generalised brain dysfunction" which was responsible for a slower rate of maturation. Money (1966) and Blom (1969) found that typical manifestations of reading and spelling problems include rotating, transposing, and reversing of letters or symbols; and a logical hypothesis has been to associate these deficits with a lack of knowledge or awareness of left and right.

Klasen (1972) reports the use of the term "soft neurological signs" in the United States of America to describe the above concomitant features of dyslexia, although Critchley (personal communication 1969)

does not favour the term. In 1961 he listed the principal neurological deficits of the dyslexia syndrome as: disorders of spatial thought; impaired temporal notions; inadequate, or inconsistent, or mixed cerebral dominance; defects in language other than dyslexia; disorders of mobility; and poor figure/background discrimination. Newton (1973) lists the observable signs of dyslexic-type language difficulties as: clumsiness e.g. difficulty in kicking, skipping, throwing, catching, climbing; defective speech; lack of concentration; low tolerance of frustration at own achievements; difficulty with directional attack, i.e. reverses or confuses order of letters, words, phrases in reading and writing; seems 'odd' - different from other children; poor retention in learning to read new work; tendency to fall easily, accident proneness; left-handedness in writing or with tools; signs of ambi-dexterity; mirror writing; restlessness, hyper-activity; discrepancy between apparent 'brightness' and school progress; normal or superior spatial and/or motor abilities; persistent disordered spelling sometimes bizarre - even when skills of reading are acquired; slowness in reading and lack of fluency persisting in some cases to adult life in spite of successes in other academic fields, occupations and competence in every day affairs. These symptoms need not necessarily be severe, in cases of slight, but puzzling difficulty, the signs are minimal. Early indicators could be: late language development; no development of a preferred hand, i.e. use of either hand for tasks such as feeding, picking up toys, manipulating objects, etc. - this ambi-lateral activity persisting to school age and beyond; early good ability in perceptual motor tasks - e.g. form boards, block-design, constructional toys, jig-saws; disordered patterning of words, e.g. "my eggs do lache", efelunt, aneths (Athens), after the normal learning stage for this kind of reversal, with a total unawareness of the disordering.

Birch (1962) describes the role of maturational lag in developmental dyslexia. He believes that a normal child passes through first the stage of discrimination and then an analysis and later still synthesis. This perceptual development is, he suggests, sensitive to

brain damage and one of the problems which contribute to a reading disability is the inadequate achievement of the higher and more complex levels of visual perceptual function. Birch predicted that among those with reading disability one ought to be able to identify cases with very defective analytic and synthetic visual perceptual capacity. An additional or complementary hypothesis also discussed by Birch (1962) conceives of a heirarchy among the sensory systems. It is essential for reading readiness that the visual system should become dominant. Children who possess a different type of sensory protocol, he postulates, make up a type with reading difficulties and find it difficult to establish visual-auditory equivalences and perhaps visual-kinaesthetic and visual-tactual-kinaesthetic relations as well. The writer has observed over many years in the specific reading and spelling difficulties of children referred for learning disabilities many of the features listed by Birch: e.g. failure to identify consistently component parts of words, suggesting analytical inability; failure to blend meaningfully the necessary phoneme/grapheme patterns, suggesting disabilities in synthesis; bizarre collections of letters when attempting to reproduce permitted spelling patterns, suggesting problems of both synthesis and analysis. Sometimes a specific ability in auditory perception is evident - a child has a superior oral fluency but finds it impossible to relate phonemic patterns to graphemic script, or is able to read by "pattern recognition" but unable to produce a written copy of his own spoken ideas. A priori, it would seem that such children have not developed a mature integrating system in the areas of the brain under discussion. Observing the types of error more closely however and the accompanying "soft neurological signs" as described above, Orton (1937), Critchley (1964), Bannatyne (1966), Newton (1973) - one could speculate that competing areas for perception in the two hemispheres would cause directional confusion in a task which depended for meaning on arbitrariness of order. Orton (1973) writes of the difficulty of laying down engrams or 'memory traces' under these conditions - a difficulty which would confound the learning task from the very beginning - especially bearing in mind the early developmental stage of the young learner in respect to these cortical features. It is possible to speculate also that a probability exists of a Birch type

of hierarchical unevenness in development and inconsistency of hemispheric specialisation for perception. Such underlying organisations could perhaps give aetiological clues to cases of extreme and chronic failure in acquiring reading skills. These ideas are indeed speculative at this stage but will be discussed further in later stages of the thesis.

It would appear from the above studies that various neuro-psychological features are observed repeatedly by different researchers: e.g. the concept of cerebral dominance and its relation to perceptual consistency/inconsistency in tasks demanding lateral order; delay in language acquisition; parieto-occipital-temporal involvement in reading and spelling difficulties; right-left confusions; motor clumsiness; disordering and rotation of letters and symbols; impaired temporal orderings; uneven development of various sensory and motor mechanisms; and time disorientations. Attempts have been made to link such psycho-neurological deficits to actual brain functioning. The ensuing behavioural manifestations are often most specifically linked to incompetencies in acquiring the phonetic/script forms of written language - the dyslexia category of learning difficulty. Such difficulties are intrinsic, i.e. within the developmental patterns of each individual person. The writer believes that such possible fundamental causes of so-called illiteracy have been grossly neglected by many educational specialists over the last hundred years. At the present time, very little emphasis is placed on such individual patterns of development by educational advisers to the Department of Education, with the alarming consequence that little relevant information is transmitted to teachers either in training or in practice. Indeed, Tizard (1972) sees no need for teachers to be aware of underlying aetiologies of learning problems, which to the writer, as a previously practising teacher of many years, is an extraordinary point of view.

The next section will describe some of the hypotheses put forward by such researchers upon which much educational practice has been planned.

1.6 THE STANDPOINT OF EDUCATIONAL PSYCHOLOGY

During the last three decades educational psychologists and sociologists have been investigating the problem of school learning failure in terms of psycho-genic factors. Their standpoint is that educational difficulties in the main derive from various combinations of extrinsic conditions; socio-economic factors, emotional maladjustment, inadequate standards and methods of teaching etc. In this country Burt (1937) and later Schonell (1948) described these precipitating factors together with diagnostic and remedial techniques. The problem of backwardness was related to the larger problem of individual differences and global view of personality development. Gates (1922) in America analysed the skills and perceptual abilities underlying the process of reading and developed tests of reading readiness. Vernon (1957) surveyed the whole field of reading failure - its nature and origin. Malmquist (1958) has written a very comprehensive account of investigations in Sweden into the factors involved in failure, especially from a practical educational standpoint.

Amongst such writers there is profound disapproval of the medical term "congenital word-blindness" to describe reading failure, with the the implication of an incurable disability analogous with colour-blindness. Burt (1947) writes:

"For the existence, however, of such congenital word-blindness, the evidence is far from conclusive. When, therefore, a child is definitely backward in some linguistic subject - backward in that subject by thirty per cent of his age - and in that subject twice as backward as in any other school subject, or in general intelligence, it still seems wiser to speak only of 'special disability in reading', and instead of assuming some gross cerebral defect, such as post-mortem inspection could alone reveal, to proceed further and enquire by actual experiment to what particular defects in various alternative mental functions the disability is to be ascribed."

The following list from Vernon (1957) represents the educational psychologists' concept of the factors causing reading difficulties, and serves as a statement for the above authors and many of their

co-workers:

1) Inadequate readiness for reading

2) General intellectual backwardness

3) Physical handicaps; defective sight and hearing; neurological defects; internal-secretionary disorders - low vitality

4) General retardation of speech development and speech difficulties; special speech defects; limited vocabulary; restricted background of experience owing to social and cultural handicaps

5) Personality factors; emotional difficulties; general adjustment difficulties

6) Social factors; environmental factors; irregular school attendance; frequent changes of school or teacher; unfavourable home conditions

7) Defective teaching methods and school organisation; inability of teacher to adjust the teaching according to the individual's ability and stage of maturity; too rapid teaching in earlier stages; inadequate supplies of reading material of satisfying interest value; too large classes.

The writer is very much aware of these precipitating causes of learning failure and will discuss them more fully in Chapter 4. For her, however, they are secondary factors in the dyslexia-type difficulty which further exacerbate the intrinsic primary, developmental problem which already exists.

Referring back to page 4 and the "confusion of aetiological identity" the present writer would attribute a good deal of the present lack of agreement on diagnosis and definition to the attitudes of those educational psychologists, who, trained in the manner of the 1940's, 1950's and 1960's refuse to accept a specific primary category of reading difficulty - at least one which can be defined by symptomology. During those years, concern was expressed at the apparently meaningless term "word-blind" which was used by some Medical Officers of Health when reporting on referrals of children with severe reading difficulties. This diagnosis appeared to close the door to remediation, to describe an apparently irretrievable condition (such as colour blindness) and ignored all the developing insights of dynamic, inter-active child-learning patterns currently being described by eminent

educationists such as Burt and Schonell. The term 'dyslexia' was considered to be synonymous with 'word-blind' and as such could not be accepted by these psychologists. Fierce resistance was expressed in the 1950's and 1960's to a concept of 'dyslexia'. It would appear that a concept of possible intrinsic causation of reading difficulty was rejected with the word used to describe it. This resistive attitude to considering individual, intrinsic central nervous system patterns in the learning of symbolic material persists in some educational quarters at the present time - indeed in the very decision-making échelons of teaching/learning policy. Tizard, in the Report of the Advisory Committee on Handicapped Children (HMSO 1972) states:

"We are highly sceptical of the view that a syndrome of 'developmental dyslexia' with a specific underlying cause and specific symptoms has been identified".

It is the writer's experience, however, after discussions and consultation with hundreds of experienced teachers that many do in fact recognise specific symptoms, many of those mentioned in the previous section. Many teachers at the present time appear to the writer to be searching for some affirmation by reading authorities of some basic cause of written language difficulty, compatible with their own observations in class-room experience. Those who are helping in the validation trials of the diagnostic instrument to be described later in the thesis express the reasons for high motivational involvement in this task as: relief at being given guidance in what to look for in individual cases of failure; relief from guilt that the fault may not lie in their own teaching methods; the promotion of new insights leading to better inter-personal relationships with failing children, since punishment is no longer a valid teaching aid; personal satisfaction in teaching in a more meaningful context; the power to plan their teaching with relevance to individual patterns of perceptual and motor growth patterns. The very first step - that of awareness of the nature of the specific reading difficulty they must try and resolve for many children - brings security and confidence to many of the teachers. It is recognised by the writer that modern

educational practice owes much to the insights of such great educational psychologists as Binet (1902), Burt (1937), Schonell (1948) Kellmer-Pringle (1952), Peel (1965) and their teachings on individual differences; differences in general underlying ability, socio-cultural opportunity and emotional experiences. It would seem possible now to add to these influential factors, first instrinsic events as revealed by studies in neurology and neuro-psychology and secondly the constraints to learning inherent in the task itself - the nature of the alphabetic sequential, directional, arbitrary symbolic system which is the script form of language. The structure of language systems and their inter-relation with human behaviour are currently being investigated by psycho-linguists and developmental psychologists. These studies will be reported in the next chapter. The way would now seem pointed to an integrated approach to written language difficulty.

1.7 SUMMARY

This chapter has described various theories and influences on the nature of specific reading difficulties. They have been drawn from education, psychology, neurology and neuropsychology. Some of the reasons for current controversy in terminology and diagnosis have been suggested, especially in relation to a category of primary written language difficulty operationally defined in this thesis as 'dyslexia'. Table 2 drawn up by Keeney (1970) could be regarded as a representation of the present situation.

Reading, spelling and writing are arbitrary, man-made systems, governed therefore by rules and regulations. They represent skills to be acquired by man in his quest for universal literacy; "new technologies to represent the underlying regularities in the environment" (Bruner, 1964). As such they need to be transmitted to each succeeding generation in some organised form. The next chapter describes the attempts of the last hundred years to achieve this goal of 'universal literacy'.

TABLE 2 KEENEY (1970): THEORIES RELATING TO WRITTEN LANGUAGE DIFFICULTY

I. Specific (primary), developmental dyslexia (strephosymbolia; dyssymbolia)

II. Secondary dyslexias (symptomatic: secondary reading retardations)

A. Secondary to organic brain pathology

1. Brain damage (cerebral dysfunction- other encephalopathy; cerebral palsy; mental retardation; low I.Q.; perceptual disorders; word blindness; visual agnosia; anomia, soft neurologic stigma)

a. Genetic
b. Post-traumatic
(1) Prenatal
(2) Natal
(3) Postnatal
c. Postinflammatory (intrauterine; extrauterine)
(1) Encephalitic
(2) Meningitic
d. Asphyxic (hypoxic) (intrauterine; extrauterine)
(1) Placenta previa
(2) Cord strangulation
(3) Maternal circulatory collapse
(4) Excessive maternal narcosis; drugs
(5) Circulatory collapse; cardiac arrest; cerebrovascular accidents
e. Prematurity
f. Other specific brain lesions (aneurysm; cyst; etc)

B. Secondary to slow maturation (late bloomer; developmental delay) (Associated with impaired lateralisation and dominance)

C. Secondary to emotional disturbances

1. Hyperactivity; short concentration span
2. Depression
3. Anxiety

D. Secondary to uncontrolled seizure states

E. Secondary to environmental disturbances

1. Cultural deprivation
2. Poor motivation (extrinsic or intrinsic)
3. Poor instruction

III. Slow readers (handicapped without symbolic confusion), bradylexia

A. Asthenopia; visual handicaps (hyperopia; heterophoria; astigmatism; binocular control abnormalities)

B. Auditory impairments

C Hypothyroid states

IV. Acquired dyslexia (lesions of dominant hemisphere, angular gyrus, and splenium)

CHAPTER TWO

DYSLEXIA IN CONTEXT

2.1 THE NATURE OF LANGUAGE

2.1.1 Neurological theories
2.1.2 Psycholinguistic theories
2.1.3 The behaviourist and environmentalist approaches
2.1.4 Developmental theory
2.1.5 Summary

2.2 THE NATURE OF WRITTEN LANGUAGE

2.2.1 Graphic codes
2.2.2 The nature of reading
2.2.3 Spelling patterns
2.2.4 Meaning
2.2.5 Summary

2.1 THE NATURE OF LANGUAGE

All animal species appear to have intricate systems of communication and according to Hockett (1960) in each species at every phylogenetic level up to man:

"the communication system shows a closer and closer approximation to human language. For man, language is a specific sound meaning correspondence.....he knows the intrinsic meaning of a variety of signals.....he knows the intrinsic connection and semantic interpretation between sound and meaning. He is able to use this sound/meaning system to control his environment and himself."

The signals in the system are first of all the sets of morphemes we call "words". Spoken words tag the processes by which the species deals cognitively with the environment. The examination of language begins, therefore, from the starting point of speech, the "first symbol system" (Luria, 1964) for although the phenomenon of dyslexia is seen as a disability of written language, it has its origins in a system of spoken communication. As Robins (1971) in his essay on the structure of language writes:

"Speech is a skill acquired by a child before writing and in the span of human history writing is very much a newcomer, perhaps three to four thousand years old, while speech is probably coeval with homo sapiens".

Darwin (1859) writing in the 'Origin of Species' states that each species is endowed with its own peculiar repertoire of behaviour patterns in the same way as it is endowed with its own peculiarities of anatomical structure. He advanced the hypothesis that:

"all the most complex and wonderful instincts have originated through the process of natural selection having preserved and continually accumulated variations which are biologically advantageous."

Could anatomical structures underlying a set of features primed for language behaviour have evolved in man as also biologically advantageous?

Wilson (1968) postulates that language ability - ie the ability to communicate orally "is an artificial and consciously organised method of control by the use of symbols or conventions, which involves the notion of meaning" and this would seem to have its roots in man's biological inheritance.

There follows a brief historical survey of the biological aspects of language behaviours and their relation to neuro-anatomy and neuro-physiology. The focus of study is the brain itself.

2.1.1 Neurological theories

Buchanan (1968) describes how the earliest known reference to the brain is in the Edwin Smith 'Surgical Papyrus' which was copied in about 1700 BC probably from an original written by Imhotep the architect-physician who lived five thousand years ago. In these writings there are clear descriptions of the brain, of the meninges and of the cerebrospinal fluid; and also descriptions of cranial injuries and their effect on the body.

After this, Hippocrates (460 - 370 BC) is the next known writer on the subject. He knew that injuries to the head had effect on the opposite side of the body. Galen (AD 131 - 201), the next great physiologist whose work was documented, knew the difference between motor and sensory nerves and also the peripheral distribution of the segmental levels of the spinal cord. Many centuries later Thomas Willis (1621 - 1675) introduced the word 'neurology' to the language and was the first neurologist. He described the vascular circle of the brain and thought that the control of movement rested in the corpus striatum, but he also believed that sensation was controlled by regions of the cortex. It was not until the middle of the nineteenth century that investigations began of the cerebral cortex of the brain. Significant amongst these studies was the work of Theodor Schwann (1839) who demonstrated that the animal body, as was that of a plant, was built of cells. Ramón y Cajal (1852 - 1934) worked on the

neuronal structures and especially the nature of the neuron, or special cortical cell. He suggested that other brain cells, the glia, had a life of their own, could move from place to place and reproduce themselves. Their role seemed to be that of caring for the myelin sheath which covers the axon or nerve fibre. Now it is known that the cortex contains about fourteen billion neurons, which do not reproduce themselves and if injured or destroyed by disease are not replaced by other neurons. Injured neurons are removed by microglia, which engulf them and carry them to the nearest venous system. Buchanan (op cit) postulates that if replacement were possible, memory could not exist and language and learned actions would have to be relearned every few months.

Localisation of function in the brain started with the work of Bouillard (1796 - 1881) and his pupil Broca (1824 - 1880). Broca is especially associated with the relationship of certain areas in the left hemisphere to speech disorder. In 1861 he demonstrated the brain of his famous patient, Tan, who had suffered from aphasia for many years and whose brain at post-mortem revealed a lesion in the left frontal lobe, in the third left frontal convolution. This later became known as Broca's convolution. Broca realised the significance of the left cerebral hemisphere for language (including reading and writing) and described the unilateral nature of the function as "cerebral dominance". (Earlier Dax (1836) had proposed a concept of unilateral cerebral dominance but his writings were not published until 1877). Marie (1901) re-examined the brain of Tan and found parieto-temporal lesions as well as lesions in the frontal lobe. Wernicke (1872) localised a lesion associated with sensory and receptive aphasia in the posterior part of the first temporal convolution of the left hemisphere. This area has become known as 'Wernicke's area' (Table 3).

These attempts to locate the functional areas in the brain which are pre-eminent for language were made by post-mortem investigations of subjects who had suffered disorders of speech such as aphasia.

The experimental approach to the neuro-anatomy and neuro-physiology of the live brain was made possible by the development of electrical methods of stimulation and recording. The first recorded electrical stimulation of the human brain was done by Bartholow (1874) and he noted that no pain was felt by the patient when he was examining both parietal regions of the brain both by galvanic and faradic stimulation. He discovered that needling of the brain substance in the parietal regions produced movement of the arm and leg on the opposite side. Cushing (1909) made detailed observations on the effects of stimulation of the human cortex during operations with local anaesthesia upon two patients who had suffered convulsions. The next stage was to record the spontaneous electrical activity of the cortex and the first recording through the intact skull was made by Berger (1925). This was the original electroencephalogram. (It will be seen in a later section how a sophisticated use of this technique was used to measure the brain activity of the two hemispheres, in an investigation comparing readers with non-readers). Brodman (1908) also used the technique of electroencephalography to plot a cortical map. The areas that may be related to visual perception in dyslexia are designated in this mapping as areas 17, 18 and 19 (Table 3).

The angular gyrus region of the brain is often described in writings on dyslexia. It surrounds the terminal portion of the superior sulcus of the temporal lobe. The relationship of this area to dyslexia was first noted by Déjerine (1892). He described the case of an adult who lost the power to read after an intra-cranial vascular incident. At post-mortem examination an infarct in the angular gyrus was revealed. An interesting finding, relating to the work of Cajal, mentioned earlier, was that of Flechsig (1847 - 1929). He demonstrated that, in the cortex of the angular gyrus, myelination develops later than in other regions. (One can speculate that if myelination were delayed even further in the case of some individuals' developmental patterns, or there is later specialisation of neurospheric regions in this regard, a dyslexic-type of reading difficulty might be the result. This could explain why some dyslexic persons are able to acquire written language skills at later stages of maturation.)

Penfield and Roberts (1959) using electrical stimulation of the cortex during essential neurosurgery indicated three areas in the major (dominant) hemisphere, stimulation of which produced some interference in speech: first the conventional Broca's area, secondly Wernicke's area in the posterior temporal region and third, the supplementary motor area (Table 3)

Coming to more modern times, researches by Gazzaniga (1965), Milner (1962), Ettlinger (1960, 1963, 1965), Zangwill (1960), Geschwind (1962), Sperry (1965) and Kimura (1961, 1963), all indicate differential functioning of the two hemispheres in relation to language. Milner (1962) carried out an experiment involving the injection of the barbiturate drug, amytal, into the carotid artery. This drug has the effect of temporally arresting the functioning of the hemisphere ipsilateral to the injection.; Thus, if the injection was on the same side as the dominant hemisphere for language, this resulted in a transient aphasia, whereas an injection in the opposite side would not cause a disturbance of language. Further descriptions and discussions on the work of these researchers will be found both in the section on "Barriers to learning" and also in later discussions. These implications of cerebral dominance for the successful acquisition of language and reading skills are central to the model of cognitive structuring postulated in this thesis.

2.1.2 Psycholinguistic theories

So far the references to cortical bases of language functioning have been in the province of the neurologist. Recently psycho-linguists, whose study concerns language both as a behaviour and as a system of rules for producing and understanding an indefinitely large number of utterances, have committed themselves to theories supporting the biological basis of language. Lenneberg (1964) postulates that there are neural structures and processes that

DIAGRAM 2

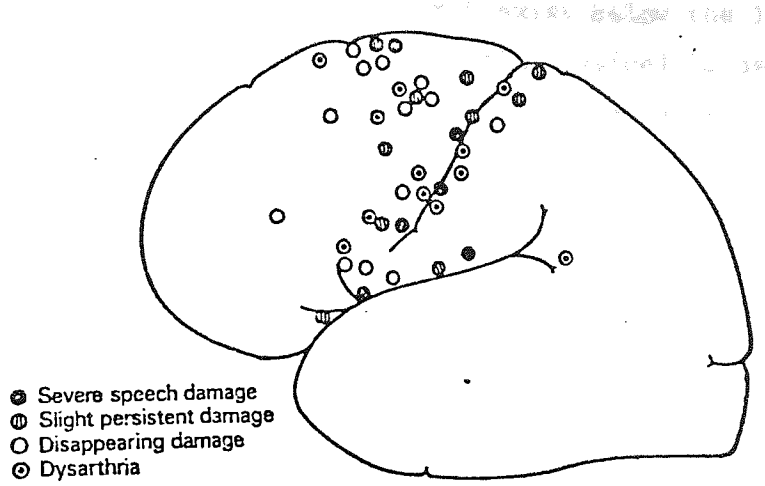


Fig. 4. The site of brain wounds causing Broca's aphasia: The severity and duration of the aphasia differ appreciably from case to case but bear no obvious relation to the site of injury. "Dysarthria" connotes defect in articulation without real defect in speech itself. It will be noted that the site of injury is in most cases anterior to the central fissure.

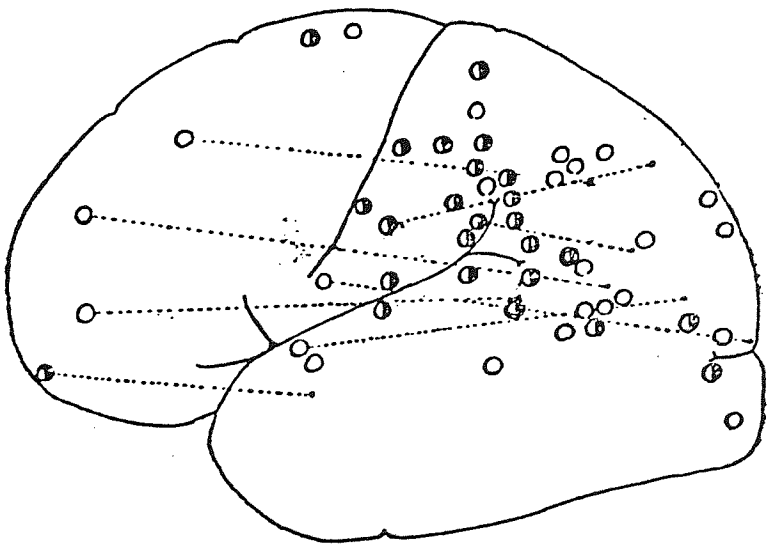


Fig. 5. The site of brain wounds causing Wernicke's aphasia: The site of injury in patients with predominantly receptive language defects is almost always posterior to the central fissure and involves principally the temporal and posterior parietal regions of the brain. The unfilled circles represent cases in which the most marked difficulty was in evoking names ("amnesic aphasia").

mediate human speech which simply do not exist below the level of man. The term L.A.D. (language acquisition device) is used to designate these structures. Table 4 presents Lenneberg's summary of language development in relation to brain hemispheric functioning. Chomsky (1969) states that:

"when a person has command of a language these kinds of information are represented in his nervous system".

He and Lenneberg postulate that when sounds are interpreted in connection with other sounds, a complex system of rules is necessary to interpret the acoustic reality that is perceived. Chomsky (1971) in his paper 'Language and the Mind' quotes Humboldt (1836) when he says:

"His (Humboldt's) theory of speech perception supposes a generative system of rules that underlies speech production as well as its interpretation. The system is generative in that it makes infinite use of finite means.....these finite materials can be combined to make a never-ending product.....the innovative element in normal use of language quickly exceeds the bounds of such marginal principles as analogy or generalisation.....acquisition of language is largely a matter of maturation of an innate language capacity.....language is a kind of latent structure in the mind."

It must be remembered that these ideas represent a possible model of language acquisition and as such they are the subject of controversy between various schools of thought.

Chomsky in particular analyses the structure of language. He takes as his unit the sentence - a string of utterances in temporal, sequential order consisting of nouns, verbs, noun clauses, verb clauses, adverbs, adjectives, prepositions, etc., arranged in syntactical, grammatical order. The Gibbon ape, one of the higher animals does not exhibit this duality of patterning in its communication system and is restricted to the use in vocal communication of a very small number of calls which are never sequentially organised. Chomsky postulates that the sentence can be perceived at two levels the surface structure directly related to its phonetic form, and a deep structure that underlies the semantic interpretation. It is the power of native speakers to grasp the deep structures of language that Chomsky terms their 'linguistic competence'. Man is apparently able to do this at

TABLE 4 SUMMARY SURVEY FROM LENNEBERG OF LANGUAGE FUNCTION

Age	Usual language development	Effects of acquired lateralised lesions	Physical maturation of CNS	Lateralisation of function	Equipotentiality of hemispheres	Explanation
Months 0 - 3	Emergence of cooing	No effect on onset of language in half of all cases; other half has delayed onset but normal development	About 60 - 70% of developmental course accomplished	None: symptoms and prognosis identical for either hemisphere	Perfect equipotentiality	Neuro-anatomic and physiologi pre-requisites become established
4 - 20	From babbling to words					
21 - 36	Acquisition of language	All language accomplishments disappear; language is reacquired with repetition of all stages	Rate of maturation slowed down	Hand preference emerges	Right hemisphere can easily adopt sole responsibility for language	Language appea to involve en brain; little cortical specialisatio with regard t language thou left hemisphe beginning to become domina towards end o this period

Years						
3 - 10	Some grammatical refinement expansion of vocabulary	Emergence of aphasic symptoms; disorders tend to recover without residual language deficits (except in reading or writing). During recovery period two processes active; diminishing aphasic interference and further acquisition of language	Very slow completion of maturational processes	Cerebral dominance established between 3-5 yrs but evidence that right hemisphere may often still be involved in speech and language functions. About ¼ of early childhood aphasics due to right hemisphere lesions	In cases where language is already predominantly localised in left hemisphere and aphasia ensues with left lesion it is possible to re-establish language presumably by re-activating language functions in rt hemisphere	A process of physiological organisation takes place in which functional lateralisation of language to left is prominent. "Physiological redundancy" is gradually reduced and polarisation of activities between rt and lt hemisphere is established. As long as maturational processes have not stopped, re-organisation is still possible
11 - 14	Foreign accents emerge	Some aphasic symptoms become irreversible (particularly when acquired lesion was traumatic)	An asymptote is reached on almost all parameters. Exceptions are myelinisation and EEG spectrum spectrum	Apparently firmly established but definite statistics not available	Marked signs of reduction in equipotentiality	Language markedly lateralised and internal organisation established for life. Language-free parts of brain cannot take over except where lateralisation is incomplete or had been blocked by pathology during childhood
Mid-teens	Acquisition of second language becomes increasingly difficult	Symptoms after 3-5 months post-insult are irreversible	None	In about 97% of entire population language is definitely lateralised to the left	None for language	

a very young age and the psycholinguists propose that the abstract L.A.D. receives a corpus of speech which is a set of utterance, e.g. the number of utterances ordinarily heard by a two-year old child. As McNeill (1966) writes:

"Upon receipt of this corpus, L.A.D. creates a grammatical system..... a theory about the regularities that appear in the corpus of speech. As with any theory, L.A.D.'s grammatical system will allow predictions of future observations - predictions of which utterances will be grammatical sentences."

Brown and Fraser (1963) analysed many hundreds of 'telegraphic' sentences i.e. two-word and three-word combinations such as 'two boot'; 'hear tractor'; 'see truck mommy'; 'Adam make tower' spoken by two-year old Adam, an American child observed by the two psychologists and concluded that Adam possessed three different grammatical classes, two of which resembled classes of adult English: nouns (boot, tractor, tower etc.); verbs (hear, see, make) and a third class of modifiers (two, a this, other, and some adjectives). In eight hours of recorded speech involving some four-hundred sentences, there were examples of every admissible combination but no examples of inadmissible ones. Again, a very young child will use the plural form 'sheeps' and the past form 'runned', when not exposed to this ungrammatical use, but having internalised the 's' plural form and the 'ed' rule for past tense. Children from other cultures, however, use similarly abstract grammatical relations in their earliest speech. The psycho-linguists postulate that they do so because of their shared inborn capacity for language.

Chomsky cites another formal 'universal' of language - that of transformations. An instance of this is quoted by Brown (1964). He says that parents enlarge a child's sentence into completely well-formed English, for example to 'doggie bite' the parent replies 'Yes, he is biting' adding the auxiliary verb 'is' and the progressive inflection 'ing'. Brown calls this process 'expansion'. He finds that parents expand approximately thirty per cent of what two-year old children say. Other transformations include the passive form

(the dog bites the boy: the boy is bitten by the dog); the interrogative; and the negative. Children rapidly acquire these forms of linguistic uniqueness, peculiar to their own native language. McNeill (1966) describes in detail how transformations could have evolved from primeval grammars by the innovation and inventive transforming of adult language by children. He states:

"According to the present view, language changed from an extremely complex system, largely free of transformations and taking many years to acquire, to a much simpler system, rich in transformations and taking only a few years to acquire. Thus, the presence of transformations in contemporary language allows children to develop language with the great speed that they do."

These features of rules, strings of utterances, of order and sequence, which combine to form the underlying structures of language, have immediate relevance to the present thesis. They would appear to the writer to be compatible with the neurological theories of cerebral dominance in that they suggest a uni-directional and lateralised system of function. The theme will be taken up again in later discussion.

2.1.3 The behaviourist and environmentalist approaches

As well as the neurological and psycho-linguistic theories, there is the behaviourist approach as presented in the "imitation-reinforcement" theory of language acquisition, propounded by Mowrer (1960). He suggests that environmental factors have an important role in a child's language acquisition. The child's imitation of an adult's speech modes and reinforcement of the child's imitative behaviour, are essential components of language acquisition - specifically related to the pre-verbal stage. The infant begins by associating sounds of the human voice, especially the mother's, with need-satisfying circumstances. When he hears his own random babbling, therefore, he is more likely to repeat those sounds most similar to the 'pleasurable' sounds of the mother. As the mother tends to reinforce the infant's sounds, especially if they approximate the adult pattern, the child learns.

Heriot (1970) writes:

"Attempts have been made to describe the learning of language by children in terms of operant and classical conditioning paradigms."

For example, the word 'drink' might be learned if the reward was experienced as a result of the response. Skinner (1957) supposes that these early operant responses take the form of "mands", "tacts" or "echoic" responses. A mand is a demand, rewarded by the child obtaining what he asks for; a tact is a naming response, in which the child names some feature of his environment and is rewarded by his mother's pleasure; and an echoic response is simply a repetition of his own or an adult's utterance, the reward being self-stimulation. The discriminative cues for these responses may be features of the external or the internal environment (e.g. the sight of the milk bottle or the feeling of a griping pain). The responses may be shaped to approximate more and more closely to adult speech.

Braine M(1963) demonstrates that children of about two years have already developed two primitive class words - a "pivot" class of very few members and an "X" class which accounts for the rest of the child's vocabulary. "All gone" is an example of a pivot word to which a child can attach a large number of "X" words e.g. "all gone, bye-bye, daddy, sticky" etc. He suggests that the child learns that a word is 'right' in certain positions and through a process of generalisation, continues to use the word in the same positions in his sentences.

Recent emphasis in developmental psychology is on the 'interaction of nature - nurture', the environment acting with the genetic pre-disposition. Luria (1964) in a twin study, describes how one child of the pair retarded in speech development is enabled to acquire effective language usage, and subsequent concept formation by exposure to a training programme, whereas the other twin without the training programme fails to acquire this competence. The power of the environment is emphasised by the above writers i.e. the experiences of language to which the young child is exposed. The following paragraphs describe other aspects of the environment.

2.1.4 Socio-economic factors

Many socio-economic studies in this country, and in America, have described the inhibiting influences of a deprived background. In this country as early as 1937, Burt was stressing retardation in school attainment, attributable to economic poverty and substandard living conditions. Studies of gipsy children, barge children, children in care and in residential homes have all revealed the failure in school learning consequent upon deprived and traumatic conditions.

In a study on cultural deprivation, carried out with negro mothers and children in New York the effects upon cognitive development and the level of conceptual language were found to be directly related to the socio-economic status of the family (Hess, Shipman 1965). Sociologists have been concerned with the inhibiting effects of restricted language experience on cognitive processes. Bernstein (1964) has used the terms 'restricted' and 'elaborated' as codes to describe the forms of speech used by different social classes. Both the latter studies describe the status-oriented rather than person-oriented life-styles, pre-conditioned by inability to use flexible and complex language-forms with subsequent deprivation in consequential thinking.

Brown (1966) describes a study by two American psychologists using tape recordings of verbal exchanges with young children. They discovered that the children internalised adult speech patterns and acquired a receptive vocabulary which became an expressive language about six months later.

It is postulated by many developmental psychologists that the first eight years are the significant years for internalisation of patterns of language

All these findings on the interaction of the developing child, the critical periods and the environment have significant implications for society and education generally and for the acquisition of reading in particular. Reference to their importance in reading retardation will be made in a later section.

2.1.5 Developmental theory

Some time in the second six months of life most children say a first intelligible word (Brown 1964). A few months later most children are saying many words - at first 'naming' words - such nouns as ball, teddy, cup, dinner etc. By one-and-a-half to two years a child will begin to use two and three-word sentences. By four years, he will have mastered very nearly the entire complex and abstract structure of the English language - assuming that environmental events, both extrinsic and intrinsic have been favourable.

As opposed to Chomsky'srationalistic conception that humans possess and develop a special linguistic ability independent of general cognition, followers of Piaget do not see language as an "autonomous object of knowing" but advocate that cognitive development proceeds on its own, generally being followed by linguistic development, or, "finding reflection in the child's language". According to Sinclair-de-Zwart (1967) in an appraisal of Piaget's work, any concept utilised in grammar has a counterpart in general cognition that is realised prior to language. Thought, argues Piaget (1963) has its roots in action: that is before the appearance of language or of symbolic function in general. Through the processes of 'decentralisation' and 'integration' the child changes from an organism that reacts to objects and events as signals to a being that 'knows' objects and events and expresses his knowledge by means of signifiers. The symbolic function can be defined essentially as the capacity to represent reality through the intermediary of signifiers that are distinct from what they signify. Thus for Piaget the first verbal utterances recognisable as words do not result simply from early prelinguistic vocalisations. They are, continues Sinclair-de-Zwart, far from being signs in the sense of belonging to a fully structured system but resemble far more symbols which can be loosely associated but which are essentially isolated representations of schemas (or internalised action)..... language is one of several means of representation, its most important being the expression and communication of thought. Slobin (1971) writes:

"human culture, social behaviour and thinking could not exist as we know them in the absence of language."

It would appear that language gives man the power to symbolise the events in his world; to free him from the constraints of concreteness and the immediate; to enable him to combine past with present and future; to understand cause and effect. Although not the only means of representing the 'recurring regularities in the environment' (Bruner, 1964), yet language is a powerful agent in human capacity for conceptualisation. Concept formation is often related to general underlying ability or "intelligence". At least since Binet's day in the early 1900's the ability to understand increasingly difficult words and define the concepts they represent has been correlated with the development of intellectual ability. It can be seen later in the section on 'Barriers to Learning' how intellectual power is related to the ability to acquire reading skills; and again in moving towards diagnosis of dyslexic-type language difficulties, how 'readiness' to read is governed in part by general underlying ability.

2.1.6 Summary

In man it is considered that spoken language has evolved as a species-specific activity. It has evolved as a rule-governed system with constraints of sequence, syntax and semantic reference. It is biologically based and the existence of an L.A.D. (language acquisition device) is postulated by some psycho-linguists. This abstract device could explain the rapid acquisition of the rules, transformations and perception of deep structures in the very young child. Behaviourists on the other hand favour an 'imitation - reinforcement' explanation of language acquisition. Neurologists have sited the pre-eminent cortical areas for language in the left hemisphere in almost all right-handed people and many left-handers. Theories of cerebral dominance for language have arisen. Maximum development of linguistic powers can be determined both by individual differences in underlying general ability and by socio-cultural conditions.

2.2 THE NATURE OF WRITTEN LANGUAGE

By processes not fully understood then, man acquires an ability to communicate in some kind of symbolic speech form and to use this communication system to mediate his thought processes.

2.2.1 Graphic codes

The second symbol system, that of a written language form, followed later in man's history. Although some form of spoken language is probably co-eval with man himself, written language as a human skill is only about four thousand years old. This system demanded a new form of competence - to quote Bruner (1964):

"an emergence of new technologies for the unlocking and amplification of human intellectual powers."

Written language enabled man to record his knowledge and experience and transmit them to an unlimited audience. He began by using a pictogram form of representation, used in the same order as speech. Pictures became symbols as when the moon was used to represent the passage of a month of time. The next step was a graphic symbol to represent a word and describe these historical events.

Moyle (1968) writes of the difficulty of representing every word with a separate graphic symbol. Chinese is one such language in which 40,000 or so symbols must be learned. The Graeco-Roman alphabet upon which our written language is based, has a far more economical and efficient system - capable of an infinity of combination and permutation, an infinite generative system based on a mere 26 symbols. For those who acquire the skill of interpreting the system easily, it is a powerful technology, but its arbitrary symbolic, directional constraints seem to be key factors in the barriers to learning experienced by the so-called "dyslexic" readers, about whom this thesis is written.

2.2.2 The nature of reading

Reading has been defined by Shankweiler and Liberman (1972) as "the perception of language by the eye". If we examine more closely the task to be learned we can analyse in more detail the skill required to achieve competence. The behaviour we call reading can be described in four categories:

1) receiving communication
2) making discriminative responses to graphic symbols
3) decoding graphic symbols to speech
4) getting meaning from the printed page.

The above categories are those described by Gibson (1965). The first of these implies that the child can speak and understand his native language in a fairly complex way, employing the units described in the previous chapter. McCarthy (1957) assesses that a child of about four years uses 15,000 words a day and will be equipped, therefore, with at least this vocabulary at school entry. Studies of young children's vocabulary size have been made by Burroughs (1957) and Thorndike-Lorge (1944). The need is for a competence in representing the events in the environment in a consistent written symbolised form, to comprehend the relationship between the referrent and the event.

The second and third stages of making discriminative responses to graphic symbols imply the perception of printed characters upon a page and the ability to decode these symbols to speech.

"Letters are essentially an instruction to produce a given speech sound and relate this meaningfully to an external event." (Gibson, 1965).

The learning problem is one of discriminating and recognising a set of line figures, all very similar in a number of ways, yet all differing in some feature.

"The differentiating feature must remain invariant under certain transformations, e.g. size, brightness, perspective, different type faces or handwriting." (Gibson, 1965)

Decoding these symbols to speech-forms has one other most critical invariant feature, however, - that of direction and sequence - which because the small number of alphabetical symbols in the system represent an infinity of combination and meaning, demands absolute consistency in order and orientation. This refers to both lateral and vertical inversions (although research finds that the lateral inversion present more confusions). Letters such as p-q, b-d, m-w, p-g, u-n, f-k, c-a, must be arbitrarily presented, recognised and recalled. The problem is not confined to the single letter. As was seen in the previous chapter, the whole structure of the language is built on a series of sequential dependencies; permitted digraphs, morphemes, words, sentences. All levels of speech and written language require this arbitrariness of form so that the presenting and receiving of communication is consistently meaningful. The task then demandsa concomitant skill in interpreting the system with the same arbitrariness. If the signal was received as "hte gob saw no sih deb" it would be difficult to respond to the expected "the dog was on his bed". Yet these representations of the stimulus words are most common in a dyslexic-type reader. If one adds to the difficulty of the task and skill the naivety and lack of symbolic experience of the learner, the difficulty of acquiring reading ability in certain circumstances becomes obvious. But what circumstances seem to be necessary to predispose the learner to easy acquisition of this symbolic task?

Developmental psychology is much concerned with the critical periods for learning the acquiring behaviour patterns. Children vary greatly in maturational levels. The progress in intellectual, emotional, physical and social growth patterns is unique to each child although based on general development sequences. There appears to be a 'readiness' time for each child to learn, accept, understand and perform the various behaviours and skills demanded by society. The acquisition of reading is one such skill. Because it is a higher order skill involving the central nervous system, especially the association areas of the brain, a certain neurological maturity is necessary, e.g. an integrity of the visual and auditory systems, the development of the myelin sheath round the nerve fibre and the integration of electrical patterning of the neurones (as

manifest in EEG rhythms). General intellectual growth must be compatible with symbolic learning. Because language implies an interaction in a social grouping, emotional and social growth must provide the necessary motivation to learn. If all these variables are organised into a meaningful stage of readiness, the "anticipatory set" or "schema" for a learning task is laid down and a state of "flash of symbolia" is possible. A hypothesis of Birch (1964) is described in Chapter 1 which deals with this concept of integrated sensory modality.

Moyle (1968) gives the following list of the abilities and general factors involved in the process of learning to read:

" 1) Intelligence: although there is by no means a perfect relationship between general ability and reading attainment.

2) Language facility: it is clear that good language development is essential to good reading.

3) Visual abilities:

(i) visual acuity
(ii) visual discrimination
(iii) left-right discrimination
(iv) visual memory

4) Auditory abilities: growth in reading attainment is largely dependent on the ability to attack a new word, therefore the child must understand that:

(i) each word has its own sound
(ii) this sound pattern can be broken down into a series of sounds arranged in a definite sequence
(iii) these sounds correspond to letter shapes, or the combination of letter shapes.

5) Physical factors: the disadvantage of left-handedness; this being even more apparent in the ease of mixed-handedness and eyedness laterality (Schonell 1964).

6) Environmental influences: 'I suggest that forms of spoken language induce in their learning, orientations to particular orders of learning and condition different dimensions of relevance' (Bernstein: in de Cecco 1967).

7) Emotional factors:

(i) attitudes to reading
(ii) general personality problems."

The writer will expand on some of these factors in Chapter 4: Barriers to Learning.

If we recognise then that an essential condition for learning a new behaviour is this prepared state of schema, with its organisation for meaning, all the elements necessary for a learning task must be received in meaningful, consistent signals. Returning again to the arbitrary nature of graphic symbols in a reading system based on alphabetic stimuli, one sees the critical need for the organism to receive the information in exact form. This thesis is concerned with presenting the hypothesis that in man's central nervous system, in which there are two hemispheres, in many respects mirror-imaging systems of information processing, there must have evolved a differential type of functioning to code these sequential arbitary symbolic signals in an ever consistent fashion. Interference in this differential function can lead to the confusion in interpreting as illustrated above, and it is in laying down the first schemata, at the very young age arbitrarily demanded by society, where the hiatus can lie. Without a first meaningful scheme, all will be confusion.

The two important dimensions of reading acquisition appear to be, then, the "sequential dependency" nature of the system, the apprehension of order, and the necessary schema-symbolia potential of the learner.

A special feature of the English orthography is the multiplicity of sounds (phonemes) which can be related to a single grapheme. The symbol "a" for instance is represented by quite different sounds in words like baby, cat, daughter, castle, cart, although. Further reference will be made to this in Chapter 4.

Attempts have been made to devise regular and consistent letter-sound relationships, by presenting augmented regular orthographies to the beginner-learner (Bloomfield, 1942; Pitman, 1961).
Levin (1936) looked at transfer to new letter-sound relationships

from learning variable as opposed to constant letter-sound relationships. In all his experiments there was more transfer from a variable list to a second variable list than from a constant to a variable one. Levin (1936) uses the term "set for diversity" and says that this set may facilitate transfer to the learning of new letter-sound correspondences which contain variable relationships - especially considering the traditional orthography of the English language. The key factor is the interaction of these three dimensions - the sequential symbolic orthography, the consistent apperception of it by the central nervous system and the "flash" of meaningful interpretation. This "flash" quality is illustrated in studies as long ago as that of Cattell (1885) and Dodge (1905). They found by tachistoscopic presentation that perception occurs in reading only during fixation periods and not in the saccadic jumps from one fixation to another. The French word 'saccade' is used to define the eye movement involved in reading. It is a "jumpy, irregular, spasmodic" but surprisingly accurate leap from one position to another. A saccade is the way we normally sample our visual environment for information about the world. In reading, saccades generally proceed from left to right across the page. During the saccade, very little, if anything, is seen at all, information is picked up between saccades when the eye is relatively still - during fixations. A comprehensive exposition of saccadic movements in relation to reading is to be found in Smith (1971). With a fast tachistoscopic exposure a skilled reader can perceive four unconnected letters; a very long word; four or more words if they form a sentence. Even very young children can read three letter words exposed for only 40 milliseconds, which is far too short a time for sequential eye-movements to occur.

2.2.3 Spelling patterns

Gibson (1965) writes of the critical nature of "spelling patterns" for assimilating written English. If potential regularities exist within words - the spelling patterns that occur in regular correspondence with speech patterns - one may hypothesise that these

correspondences have been assimilated by the skilled reader of English and have the effect of organising units for perception. It follows that strings of letters which are generated by the rules will be perceived more easily than ones which are not, even when they are unfamiliar words or not words at all.

The structure of each language contains many permitted digrams and trigrams i.e. accepted two and three letter sequences of sound-blends. Examples from the English language would be th, wh, st, br, dr, ee, ea, er, str, thr, tch. The existence of these spelling patterns can be effectively exploited in the early stages of learning to read and spell. Similarities and generalisations can be made into key teaching strategies. Attention can be drawn to these features and words analysed into patterns of phoneme/grapheme clusters, for example:

stand	where	meet	far
stay	when	feet	car
stair	what	been	star
start	why	deep	garden

The lively teacher will find many ways of reinforcing the learning of these patterns and providing opportunities for the internalisation and subsequent generalising of the rules. First the direct teaching of the rules, before the conscious attention to the irregularities.

Gibson (1965) refers to spelling patterns as "clusters of graphemes in a given environment which have an invariant pronunciation according to the rules of English". In an experiment, Gibson, Osser and Pick (1963) she investigated how early, in learning to read, children begin to respond to spelling patterns as units. The experiment was designed to compare children at the end of the first grade and at the end of the third grade in ability to recognise familiar three-letter words, pronounceable trigrams, and unpronounceable trigrams. The three-letter words were taken from the first grade reading list; each word chosen could be rearranged into a meaningless and unpronounceable one (for example, RAN, NAR, RNA). Some longer pseudo words (four and five letters) taken from the previous experiments were included as well.

The words and pseudo words were exposed tachistoscopically to individual children, who were required to spell them orally. The first-graders read (spelled out) most accurately the familiar three-letter words, but read the pronounceable trigrams significantly better than the unrponounceable ones. The longer pseudo words were seldom read accurately and were not differentiated by pronunciability. The third-grade girls read all three letter combinations with high and about equal accuracy, but differentiated the longer pseudo words; that is the pronounceable four- and five-letter pseudo words were more often perceived correctly than their unpronounceable counterparts. These results suggest that a child in the first stages of reading typically reads in short units, but has already generalised certain regularities of spelling-to-sound correspondence, so that three-letter pseudo words which fit the rules and more easily read as units. As skill develops, span increases and a similar difference can be observed for longer items. The longer items involve more complex conditional rules and longer clusters, so that the generalisations must increase in complexity. The fact that a child can begin very early to perceive regularities of correspondence between the printed and spoken patterns, and transfer them to the reading of unfamiliar items as units, suggests that the opportunities for discovering the correspondences between patterns might well be enhanced in programming reading materials. It is significant to note here that approximately eighty-five per cent of the English language is governed by rule-regularities.

2.2.4 Meaning

Broadbent (1958) points out that, although the component stimuli for speech and reading are spread out over time, this does not mean that phonemes or letters or words are processed one at a time, with each stimulus decoded to a separate response. Letters, words etc are read in context and never responded to in isolation. Not only are the sequences constrained by the spelling patterns, but by context and meaning. The strings of symbols, organised into

patterns have "signification" - they signify meaningful events. This is the semantic aspect of reading which the young learner must be able to assimilate concomitantly with his mastery of the techniques. This derivation of meaning from context highlights one of the major differences between the skills of reading and spelling. Learning to read is a continuous, improving, dynamic activity helped by the redundancies in the underlying system and the relationship with meaningful events. Spelling is an all or nothing activity. Each new pattern must be learned in its own right. It is a discrete task. Another feature of difference is in the "expression" quality of spelling. The learner must not only recognise a meaningful pattern, without the written template before him, but recall the sequence of symbols and express them with arbitrary correctness. There is a secondary active task to be accomplished in reproducing a spelling pattern. This feature of active recall is also present in the writing of language. Written language expression not only calls for the internal organisation of ideas into meaningful strings of language form, but also for the ability to reproduce these strings in matching fluency of graphic form. This involves the discriminatory, decoding, semantic and syntactic aspects of language. The retrieval from memory of the desired ordered strings of spellings and fluent syntax appears to be a prime difficulty in the dyslexia syndrome.

In the school system, the three aspects of language - reading, spelling and writing - are often combined as integral parts of a total system. It is considered by many teachers that each separate activity gains in accomplishment by its concomitant association with the other two; the learning of reading and language thus becomes a holistic, meaningful experience:

2.2.5 Summary

In conclusion, one turns again to Gibson (1965):

"Reading begins with the child's acquisition of spoken language. Later he learns to differentiate the graphic symbols from one another and to decode these to familiar speech sounds. As he learns the code

he must progressively utilise the structural constraints which are built into it in order to attain the skilled performance which is characterised by processing higher-order units - the spelling and morphological patterns of language".

As Klasen (1972) writes:

"reading is a complex and continuous function, extending from simple sensation to complicated intellectual processes, all inter-related".

But what if there is a barrier of confusion at the very outset of this arbitrary, ordered symbolic task - in organising these meaningful units of perception? How to develop a skill depending upon assimilated correspondences when the original perception can vary at random, at any one time from 'hte god saw no ihs deb', through all its permutations of possible sequences to 'the dog was on his bed'. The following section examines the conditions under which transmission of the skill of reading has developed in a Western society. Subsequent sections will record and discuss the barriers to successful acquisition of the system.

C H A P T E R T H R E E

THE TEACHING AND LEARNING OF READING

3.1 THE TEACHING AND LEARNING OF READING

This section attempts a brief historical survey of the events and personalities influential in shaping the pattern of teaching in primary stages with special reference to the acquisition of reading skill.

3.2 THE 1870 EDUCATION ACT

The Education Act of 1870 introduced compulsory school attendance for all children in Great Britain once they reached the age of five years. The advent of the Industrial Revolution created a situation for society in which the need arose for its citizens to learn to "read, write and reckon". Implicit in the Act was the assumption that having made the decision, built the schools and provided the teachers the actual acquisition of the desired skills would be automatic - a simple stimulus-response event. The emphasis was therefore on direct authoritarian teaching; the child was the passive recipient of a rule-generated system. D.H.Lawrence graphically describes the learning scene:

"The school squatted low within its railed asphalt yard..... the building was grimy and horrible.....this was the big room. Standards five, six and seven.....There was a small teacher's desk facing a squadron of long benches, two high windows in the wall opposite. There it was, this class of fifty-five collective children depending on her (teacher) for command.....she could not speak as she would to a child because they were not individual children, they were a collective inhuman being.....so that the first great effort of every teacher of a large class must be to bring the will of the children into accordance with his own will.....she was impersonal enough to punish where she could have otherwise only have sympathised; understood.....it was all made up, so unnatural. The school, the sums,the grammar, the quarterly examinations, the registers.....it was all a barren nothing."

Teacher training was meticulous, tidy, thorough and subject-oriented. The writer's mother was at college with Lawrence and her exercise books are filled with detailed lesson notes - "Aim; Exposition; Re-statement; Conclusion. Notes about everything from Natural Sciences to swimming. The beginners and younger children attended the "Infant" department. The entrance class-room was dominated by a huge board to which was attached a manual of letters. The

teacher turned the handle, the manual rotated and each line of alphabetical symbols was indicated by a long wooden pointer while the children chanted and intoned the required responses; a kind of mass ritual. This chanting seemed to be a system on its own, a separate drill, not perceived in many cases as being related to reading. In fact the paradox often arose of not being given a reading-book until one could read, so to speak! Strong moral tones accompanied the reading situation in accordance with the strict principles of the day. To make a correct response was "good" and the positive reinforcement was linked to the "goodness"; to fail was to be "bad" and the negative reinforcer of punishment was accordingly linked to the "badness". The perceived need was to conform, to obey, be correct, rather than to read. More recent educational theory suggests that this type of reward and punishment inhibits concept learning and meaningful continuity of experience (Peel 1965). It could also produce a dependency upon external authority rather than a responsibility for one's own independence of thought and learning - but this is a much larger question of the true purpose of education, discussed later. Altogether one is inclined to speculate of this period of learning that children who were ready anyway, i.e. children with the "readiness" described in the previous chapter and faced with these minimal props from the environment did acquire the skill and proceeded through a strict training in pothooks/spelling, phonics, parsing and grammar to a pragmatic level of literacy. For individual cases of "non-readiness" there was a miserable punitive road to illiteracy.

3.3 THE MODERN PERIOD

Towards the end of the 19th Century, however, more enlightened and liberal concepts of education were being introduced from the writing and works of educational philosophers and psychologists. In particular the writings of Rousseau (1762) and his image of the 'noble savage', the child left free to develop as a creature of the earth un-trammelled by a punitive and artificial industrial society; Froebel (1913) and his concept of a 'child garden' where the developing child was nurtured in an environment provided with appropriate stimuli and in which all was learned through self-involvement; Montessori (1912)

and her idealised teacher-child system represented in an icon of the day in which was depicted the child seated in a boat being guided safely down the river of life by the teacher. For Montessori, too, education proceeded by child-centred activities, training schemes related to competence in everyday affairs. Today her sense-training apparatus once so fashionable in Nursery Schools, is finding new purpose in the sensori-motor education of children born 'at-risk'.

Also influencing this growing awareness of the needs of the individual child in educational systems were Dewey (1902) in America and Pestalozzi (1912) in Italy. Learning was now recognised as something more than a passive stimulus-response event - it possessed a dynamic child-centred quality which was only achieved by 'experiential' methods. True educational learning was recognised as a different process from rigid training.

3.4 THE ACTIVITY METHOD

By the late 1920's, these philosophies had found their way into several progressive teacher-training colleges - e.g. the MacMillan in Deptford; The Froebel Institute; Roehampton; and Gipsy Hill College, then situated in South-East London. These colleges educated teachers in the importance of the early education of young children. Preparation for more formal learning was instituted in the Nursery School and Class. Here the child was directly involved in play of all kinds, experiencing the constraints and possibilities of mass, capacity, mechanics, language, number, etc., in a carefully prepared environment. Social, emotional, physical and cognitive growth were all fostered. The child was to enter Infant School at five, equipped with all his experiences, of which pre-reading activities were an integral part. The "activity method" as it was sometimes called continued in the Infant School and projects were the order of the day. Education in the "three R's" was centred around some topic within the everyday experience of the child - the shop, the farm or post-office etc. Reading a number learning were experienced as a meaningful part of a realistic event. Labels, lists, notebooks, bills, diaries, news sheets were all spontaneously written by teacher and children to meet the need of each occasion as it arose in this dynamic learning situation. The

class-room walls were festooned with charts, name cards and notices, everything in sight had its own label - "door", "window", "blackboard" etc. The "book-corner", with display stands and shelves for reading material, was a central feature in this prepared environment. A key text-book in such progressive Colleges of Education of the day was "Modern Education of Young Children" (Catty 1933).

The essence of the activity method is distilled in the following passage, taken from this book:

".....the aim was to make the school a natural place for the child and let him develop freely along his own lines.....the classroom has been arranged to give the greatest possible amount of free floor space and adequate provision has been made for storing materials.....as the room is to be a laboratory in which children learn, the environment is planned to possess all facilities for constructive interests.....in the freedom of the child-centred classroom, individual interests develop mainly along the lines of the children's natural play interests, e.g. houses, families, shops, traffic, school, etc..... the teacher is aware of the personalities round her, constantly growing through their interests and the stimulation and sympathy of their community. She wants to know that everyone of her large class is engaged profitably.....growth is accomplished through the child's effort and his purposeful activity and not by our over-seeing or constant direction."

Reading and writing evolve naturally as described in the following passage:

"At the age of 5, while the children were still playing in groups, many requests were made for help in the writing of names. 'How do you write "garage"?' 'Will you make me a copy for "Fill up here"?' 'Will you write "Oxford Street" for me?' etc., etc. The children who were making a shop wanted to label their goods 'butter', 'oranges', 'lollipops', 'nuts' and so on. Alfred asked, 'How do you write "Victoria Garage"?' Frank wanted "To the end of the road" written - that was where his bus was going. Someone bought a stamp and paper in the post-office and asked help to write a very simple letter. Then one day a request came 'Write up that this is my house', and a notice had to be written that 'This house belongs to Ronnie'. Another day Harry made a large rough ship from boxes and was charging a penny for a sail. 'Where does your ship go to?' asked the teacher. 'Everywhere' was the reply, 'and will you put a notice up about it?' Together we composed 'Harry's ship goes everywhere'. 'Write about my school'; 'Put up some writing about my motor-car'.

Soon there was a library (on cards) about the activities. The notices and posters were placed near to the game. Sometimes a tour of the room was made and the class discovered all the 'stories'.

At another time, they were used as games, seeing who was the quickest to recognise a story. Another day, all notices were collected, and the game took the form of putting them back in their right places. One 'story' may be taken down and individual words covered up while the children guess what is hidden, or quick recognition of words in the manner of a spelling-bee forms a cheerful game. Often a child would go round the room tracing out these sentences along.

Laura used a 'story' in quite a different way. She failed to attract a visitor's attention and wandered away till she found the sentence that was written one day to please a little shopkeeper - 'See me play at shops'. She covered herself with it and approached the visitor who could not now fail to notice the little girl enveloped in a large card. When the much desired attention was focussed upon her, she refused to speak, but indicated triumphantly the written words, and we guessed correctly that she wanted her to see her at play with her shop.

As children grasp the idea that the written word conveys stories through the eye, as language conveys them aurally, they have a great desire to learn. 'Will you show me how to read?' will often be asked by one of a small group about the age of $5\frac{1}{2}$ years. It is quite practical to begin with these children, who wish to learn or, for some purpose they have on hand, find an urgent need to do so.

A new centre of interest now begins - 'The Reading Class'. While the majority are playing, the little group gather round for their lesson. Others come to join in. It is wise sometimes not to admit a great many at once but to have a waiting list of those who desire the privilege of learning - 'I shall be ready as soon as you can have me', asserted Sheila. She came with alacrity a few days later. A group which began to learn to read in this way grew to twenty-six children in two months, each one a volunteer.

That reading class gradually became the 'School' - and was itself a project. A large placard intimated 'This is the way to the school'. The members had their own boxes with pencils and books. The 'School' was surrounded with signs of formal work, e.g. beads, reading games, writing materials, wall records, books, etc. Provided they came to the group lesson of fifteen minutes each day, they were free to do their individual work when they liked. The rule of the 'School' was established that only quiet occupations should be followed there. If a child wished to do a puzzle, or formal game, to make a scrap-book, to thread beads or look at books, he settled himself in the 'School'. Their first reading exercises, after various games, were the fifteen Beacon Reading Cards, and then a very simple story book. Many times during the day a child would say 'Will you hear me this card?'. Their rate of working differed considerably, but in every case, the maximum effort was made. In some cases time for free play was spent in mastering a new card. Any adult who visited them was sure to be asked to come and help.

.....When children come to understand the stores of delight which books contain, their interest urges them to any effort to achieve the power of reading and discovering treasures for themselves.

Let us now suppose that the children are about 6 years old, they have combined in a class project, and that a certain number have begun to read. Whatever the centre of interest, there will be many opportunities for them to realise the necessity and advantages of reading. 'News' or 'Bulletins' are written up each day and pinned to large boards. They come eagerly in to look at the 'News'. 'What is it?' 'What does it say?' 'Do read me the news' are the urgent requests to those who can already read. Once the news is known the fingers begin tracing the words and the news is often repeated. To be able to read the Bulletins, one must join the 'School' where the lessons are taken round the news after the manner of the sentence method.

.....Activity, speech, hearing and feeling with fingers can all be made valuable servants, once the desire to read has been felt, the need realised.

Above all, the learning process must be connected in the child's mind with happiness, pleasure and successful results. Let the games be jolly, the reading class always pleased with its achievements, and let encouragement be the watch-word. If a child begins to feel that reading is difficult, and that he can't do it, an emotional barrier of inferiority is set up and the teacher acquires an attitude which is fatal, when she says 'This child will never read'. They do not all learn in one way, but the normal child in the atmosphere of freedom has more opportunity of finding his own way. Finally there should be no blame or suggestion of shortcoming if the desire to read is not expressed. What effort and interest will not accomplish, no amount of external force will achieve.

.....With such understanding pervading the class, it is possible at a conference to explain that the children have now reached an age when definite practice times have to take place in order to equip them for life in the junior school. Fifteen minutes' concentrated practice each day from willing minds is worth a far greater number of minutes under external compulsion. The children must quite understand what is required of them and be given record cards for their own use. Of course, quite a number will enjoy a longer reading time, but if so, it should be entirely their own choice. It is, however, necessary to preserve the attitude that reading is a pleasurable occupation, that the approach to it is fraught with no great difficulties and that the end is surely attainable.

About this age one might suggest that the children's attention could be called to phonetics and an added help be thus given them towards fluency. 'What is this word?' someone asks. If it is such a word as 'door', and the opening leads to a consideration of words sounding the same, lists of these words are made and others follow in order that the children may possess another tool to use when teaching themselves. By reading aloud from her own books, or from theirs, the teacher cultivates the point of view that books are 'magic casements'. The class-room library is extended to include books of reference, so that information required for the conduct of the project may be looked up. As many story books as possible should be on the shelves while a broad classification of 'hard' and 'easy' would help the children to the selection of suitable books.

Writing cannot be separated from reading, for to the children they appear simultaneously as arts that will further the purpose in hand. Writing lessons as such and without any objects are unknown in the child-centred classroom. The children write because there is something which must be written. Catalogues, letters of thanks and letters of invitation, admission tickets, lists of patients and washing are all required. 'How do you write so-and-so?' is a constant cry. The necessary help is given to the group and any others who want it."

So we see that the aim was for the acquisition of reading to develop naturally through the maximum involvement of the child in a structured, meaningful environment.

Teaching the beginner school-learner is ideally an extension of the primary social situation in which the child learns in a one-to-one relationship with the mother, the skills demanded by society. The child would learn to read naturally in this type of relationship, provided all the techniques were available. Indeed true remedial teaching, when the original class teaching has failed, takes place in this understanding, facilitating one-to-one relationship. Catty describes how the same inter-personal concern for the noviate-learner can be translated into the classroom scene and describes the role of the teacher in this catalytic teaching method.

3.5 THE BEACON METHOD

Reference is made above to the Beacon method of reading. This was one of the earliest methods to use an individual-child approach in its carefully graded books, work cards and reinforcing apparatus.

One of its chief merits was probably the mnenomic system relating the phonetic representation of the letter to its graphic counterpart. This transfer was effected by use of short stories, linking the sound meaningfully to the events and characters. The stories revolved round the family scene of mother, child and baby and could be used to dramatic effect by the Infant teacher. The interest aroused served as a powerful motivator and was reinforced by reciting, copying, colouring and tracing activities. The system also had the advantage in that it was not a total waste of time as a large group teaching method. The stories were appreciated by the whole infant class (at various levels of understanding). The vowel sounds could be isolated for blending into single syllable familiar words and the words displayed on the board, differentiated by coloured chalks. Rhyming patterns were used as mnenomics and reinforcers, e.g. 'a' written in red chalk, listed as cat, sat, rat, fat, mat, etc., 'o' in blue chalk, listed as got, lot, tot, cot, dot, etc., 'i' in green chalk, listed as hip, pip, rip, tip, sip, dip, etc. These lists could be made up into booklets, dictionaries, book markers, pictures or traced onto cards. Learning was continually strengthened by an active involvement in the task.

A third advantage of the Beacon method was the actual content of the stories presented in the first readers. These stories revolved around the archetypal fold-myths and tales - Chicken-licken Little Red Hen, The Goat and the Seven Little Kids, Three Little Pigs, etc. These stories formed an early introduction to the enduring narrative of folk-literature.

A disadvantage of the system, exacerbated by the large number of children in each class, lay in the boxes of apparatus linked to the preliminary reading cards. Very small strips of the text and single words were reproduced for matching and sorting, a set being prepared for each card. As five and six year olds do not possess even rudimentary skills in the uses of filing systems, a chaotic jumble of these "job-aids" would litter the Infant room floor at the end of a busy morning and provide hours of unproductive tedium for the frustrated Infant teacher. Many later reading schemes were to share this well-meant but unrealistic aspect of teaching in the large-class situation.

A serious problem for the young beginner-teacher at this time was the conflict in the goals and aims of teaching between her college-inspired idealism and the expectation of the established authoritarianism of many of the Head Teachers. The writer remembers vividly her first day as a teacher in a North Country primary school. The brief, shrewd appraising glance by the Headmaster, the ruthlessly over-simplified decision "The entrants class for you; you're small, the children are small, the desks and chairs are small - we can get about sixty in here" - a logical procedure to satisfy any systems planner! Actually fifty-five children arrived with chronological ages ranging between $4\frac{1}{2}$ and $5\frac{1}{2}$ years, but mental ages varying from 2 to 9 years. Many suffered severe separation problems, especially the boys. Reaction patterns varied from sobbing quietly, screaming loudly, being sick, incontinence and regressions to negative forms of behaviour. Many had little social competence in handling personal needs and the day passed in a confusion of buttons, laces, gloves and odd wellington boots. "Individual concern in a safe environment" resolved itself on that first day in an intense effort to learn every child's name and address them personally at least once. In this traumatic situation for both teacher and children, lay the beginnings of school learning, especially reading. The Head had warned "None of that expression nonsense in this school, your job is to teach all these children to read by the end of the year". His room was near the classroom and his expectations made quite plain by the swish of the cane as 'top-class' boys were punished for not deriving meaning from this chaotic press of events in earlier days. The situation certainly seemed more savage than noble. Former colleagues from College, in similar situations, (the intelligent ones no doubt!) left teaching to join the Services, became Air Hostesses or rushed into early marriage.

In this situation the Beacon method of reading, taught within the context of a child-centred approach to education, proved a great strength. For the older children in the class, there was little problem. The discrete analysis of phonetic sounds, blending into permitted digraphs, reinforcement of the spelling-patterns as described in the previous chapter, all made explicit the techniques

of a rule generated system. Within the higher ranges of mental ages in the class, the required readiness for internalising such symbolic rules was reached. In the teaching of reading it is important to emphasise this rule aspect of the task to be learnt. Studies of illiteracy are apt to select inconsistencies of orthography, e.g. phonetic representation of the grapheme "a" in cat, baby, caught, dictionary, cart, late, castle, breakfast, etc., whilst ignoring the fact of the many inconsistencies in spelling rules.[1] There appears also to be a peak learning time for the laying down of these 'engrams' of recurring regularities in the central nervous system by reinforcement and repetition. The pre-pubertal stage of development, i.e. primary school age, mental age approximately between $6\frac{1}{2}$ and 9 years appears to be a critical period for this sort of rote-rule learning. The task seems to be not only intellectually meaningful, but the rhyming and repetition by their very pattern and predictability give a pleasant effect related to some resolved expectation - a context of security, so to say. To present a well-structured analysis and synthesis of the components of language at this stage therefore seems an economical and efficient means of presenting a system. If left until later, it can become a chore; if left to be educed from an unstructured environment, it can result in an insecure muddle. This muddle can be due to wrong cues being selected in a trial and error situation, with no immediate guidance in selecting and reinforcing the correct response. One can exploit this "readiness" stage in the class-teaching situation without necessarily reducing the learning to a mechanistic barking-at-print drill.[2]

The difficulties of teaching a group of fifty-plus $4\frac{1}{2}$ to $5\frac{1}{2}$ year olds to acquire competence in a symbolic learning task reside in the dynamic, underlying processes of individual human development and the

1. Ref. previous section (page 52) - eighty-five per cent of English orthography is regular.

2. The present emphasis on open-plan teaching can militate against some children (eg. those with dyslexic-type difficulties) acquiring the rules

unevenness in growth patterns. Good teaching has its maximum effect at a certain time when all the complex variables "make sense". This readiness time depends to a great extent on the developing patterns of growth and also on relevant experiences learnt from home and society. Given fifty-plus differing potential patterns, the problem becomes one of enabling each individual to engage in a truly meaningful continuity of learning, based on adequate schema and a subsequent sequence of developing insights. The assimilation of rules externally taught is only a part of this learning - a necessary part, but only a part.

3.6 PSYCHOLOGY AND EDUCATION

Leaving aside such practicalities of actual school organisation, we turn to consider two other important influences on the teaching of reading, stemming from the work of psychologists in the early nineteen-hundreds. One of these was the Gestalt school of psychology. It was a movement away from the associationist theories of the day. Emphasis was laid on the dynamic nature of perception, the effort after meaning and the instrinsic nature of figure/ground perception. Although originally concerned with the way in which man perceives, it soon began to have an important influence in learning theory. The dictum was that symbolia and insight were only possible when a simultaneous appreciation and organisation of related events took place and this was thought to depend on unitary psychological processes in the brain cortex. This theory tied in with the "flash" quality in reading recognition, earlier discovered by Cattell (1885) and Dodge (1905).

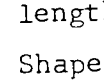
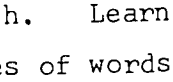
The word "Gestalt" is taken from the German and means "form" or pattern. The so-called Gestalt School was founded by three German psychologists, Koffka, Köhler and Wertheimer and arose from Wertheimer's studies on apparent visual motion, published in 1923. Gestalt theory lays emphasis on the organisation of experience into meaningful patterns or "conceptual maps". Thus its strong influence on theories of perception and learning. For the former,

"Gestalt Laws" were formulated setting out the characteristics of a good "gestalt", e.g. clear definition of figure-outline either by line or contrast boundary; the cohesive force of patterns whose component parts are arranged in close spatial proximity; the law of prägnanz or precision referring to "goodness" of figure, the delineation of pattern by grouping similar parts. These laws can be invoked when preparing a meaningful reading text for beginner-learners, or underlie the preparation of children's own work-books. They were also used to effect in the page-formats of the new readers in the 1940's.

Two Gestalt laws important for learning are 'perceptual set' and 'learning set'. These laws imply that the learner is in some relevant frame of reference and that new learning will relate to known fact, to satisfy the human need for "effort after meaning". The responsibility, therefore, is with the teacher, to plan material which evokes the desired response; otherwise children will devise their own "logic" (Our Father, Harold be Thy Name).

Köhler W(1959) was especially interested in learning and problem-solving by "insight". He claimed that provided all the elements of an event are present and within perceptual range, the solution occurs as a sudden flash of insight, a "symbolia", which probably results from a rapid organisation in critical areas of the brain of the perceived elements, to produce what the Americans refer to as the "ah-ha" experience. This symbolia experience is especially linked to reading. Many educationalists judge it to be the truly effective way of teaching a skill whose object is the transmission of meaning by symbolia representation. It is contrasted with the "barking-at-print" method which is induced by mechanistic phonetic drills taught in isolation and irrespective of proper "perceptual set". Apart from motivational problems, there is the difficulty in this method of generalisation and transfer of rule.

Utilising an 'insight' or Gestalt technique, spelling and rules of syntactical structure can be linked in a global fashion to a meaningful context. The Gestalt influence played its part in the teaching of reading then, emphasising meaning and the dynamic [illegible] of the learning-teaching situation.

Developmental psychologists supported this "global" approach, querying the ability of young children to do discrete analysis of symbolic patterns. They also postulated that a whole word shape at this stage was a more meaningful unit for recognition. So in the early 1930's a new approach was introduced into the teacher training colleges, that of the "Sentence Method" or "whole" approach to reading, described comprehensively by Luke (1937). Emphasis was on the meaningful content of the verbal stimulus and the beginning unit was the sentence, which was taught initially as a pattern to be recognised as a global entity. Teaching material consisted of many prepared "flash" cards, containing sentence length, thought-unit length, word and eventually letter length. Learning proceeded by visual pattern recognition. Shapes of words were cut from cards, e.g.  ,  ,  ,  , and were first learned as disparate shapes by matching and sorting games. Later the words were added and again learned by play. Finally, the shape-cards were discarded and the words recognised in pure symbolic form. The break-down into component graphemes came later and into phonemes much later. Like many uni-dimensional attempts to teach reading the baby was thrown out with the bath water - in this case the phonetic 'baby'. As language and speech (first symbol system) are essentially a phonetic system, at least half the sensory data were ignored in this method of transference to the second symbol system - reading: ironically enough as the approach was considered to be a "whole" one. The clutter of apparatus with large classes and the unrealistic formalism of this system was to prove frustrating to many teachers. Often this lack of motivation was reflected in the childrens' own lack of acquisition of learning. In spite of elaborate forms of training whilst at college, young teachers thankfully - albeit sometimes guiltily - accepted the older Beacon type methods of class-teaching which they found already established in the schools. This sentence method eventually resolved into the well documented "look-and-say" method of the late 1930's and 1940's. The controversy on teaching method, phonetic, or look-and-say, is still a matter of contention in educational circles today. On feasibility grounds alone, it would appear that in learning reading as in learning anything, the

human organism would employ all relevant sensory mechanisms; in this case auditory, visual and kinaesthetic channels. Emphasis on one or the other will vary at different times of course, and in the case of children with specific difficulties, special reinforcements will be necessary. But basically speaking the controversy seems to be founded on limited thinking and fixated in a false dichotomy. Multi-sensory approaches to the teaching of reading are as essential for the primary stages as they are for later remedial schemes.[1]

Developmental psychology began to play a significant role in the understanding of individual child patterns in Paris, in the school system around the turn of the century. Earlier in England, Galton (1869) had postulated four characteristics of general underlying ability in man, viz: that there are individual differences in its incidence, that these differences are inherited, that they follow the normal curve of distribution amongst the population and that the interaction of "nature and nurture" could modify the effectiveness of this so-called "intelligence". Continental psychologists were greatly influenced by these biologically-oriented theories. Amongst them was a distinguished French Psychologist, Binet, who was asked in 1904 by the French Ministry of Public Instruction to devise some means of assessing children in their first years of school attendance, on their capability to benefit from formal teaching. It appeared from the level of failure in these early classes that some children had intellectual barriers to learning and would at best need special education. How to measure the potential needed for successful performance was the problem. Binet devised the simple, yet at the time brilliantly original, concept of an "age" index. He worked from chronological ages, selecting tasks successfully performed from aged 2 - 16 years and standardised these tasks over thousands of children. A "mental age" was derived from the maximum correct responses at each chronological

1 A system of remedial teaching designated as V.A.K. is used by Agnes Wolff of theBath Institute of Dyslexia. This Visual-Auditory-Kinaesthetic approach stems from the early training methods of Samuel Orton.

age level, e.g. a child of 6 years fulfilling all the tasks up to the level of 6 years would be said to have a mental age of 6 years; if capable of performing up to the 8 year level tasks, a child would concomitantly have a mental age of 8 years. Conversely if only able to answer correctly to the 3 year old level, he would be said to have a mental age of 3 years. Thus, it could be adduced which children were not ready for the formal school programme. The critical ratio was $\frac{M.A.}{C.A.} = 1$. This was later developed by Stern (1937) into the Intelligence Quotient (I.Q.) using the simple expedient of multiplying by 100.

This technique of "mental measurement" has dominated thinking in educational psychology for the past forty years and it will by seen how concepts of backwardness and retardation in school attainment, especially in reading, have developed from Binet's original work. The instrument devised by Binet was translated and adapted for English speaking children by Terman and Merrill (1937) and has been revised for British children, the latest revision being in 1970. This test known either as the "Binet" (in America) or the Terman-Merrill, is still a much used clinical instrument for assessing individual 'differences' in the so-called innate potential of children referred for school problems. Another test of intelligence, the Wechsler Intelligence Scale for Children (1949) - the WISC - is now preferred by some psychologists as it has a performance scale as well as a verbal one. The Terman-Merrill is considered by some to be verbally biased. Reading was recognised as a symbolic skill, needing a critical level of intellectual ability in order to acquire the necessary competence. This level was considered to occur at about M.A. 6 years.

3.7 MOTIVATION AND LEARNING

Meanwhile Gesell (1939) in America, was developing techniques for tracing patterns of child-growth through sensori-motor activities to symbolic language competence and relating these stages to the chronological ages of children; e.g. in motor behaviour, at

average 28 weeks, a child will sit alone, erecting his trunk for a whole minute; at 40 weeks, sitting equilibrium is mastered; prehension shows refinements - the volar pad of the thumb opposes the volar pad of the index finger. At one year he can creep, pull himself to standing position unassisted; he can release a ball with a throwing thrust. At three he can make controlled marks with a crayon; the maturation of neuro-motor equipment enables him to build a vertical tower with 9 or 10 cubes and he can fold a piece of paper lengthwise. At five he can skip, stand on one foot and pluck a dozen pellets one by one and drop them deftly into a bottle, he can draw a recognisable man.

In language development at average age of 28 weeks a child emits spontaneous vocalisations producing vowels, consonants, syllables and dipthongs and is comprehending the tones of voices and inflexions. At 40 weeks the neuro-motor network gives increasing dexterity to the tongue and lips and this combined with imitativeness, favours articulate vocalisation; he manifests a socialised responsiveness which will inevitably lead to speech. At one year he repeats accustomed words; he responds to such commands as "Give it to me". He says several words and many vocalisations leading to expressive jargon. At three years words become instruments for designing percepts, concepts, ideas and relationships. Vocabulary reaches an average of 1,000 words - he learns to listen and listens to learn. At five he talks without infantile articulation, he asks questions for information. He has assimilated the syntactical conventions and expresses himself in correct, finished sentences - all types of sentences including complex ones with hypothetical and conditional clauses. He is, however, unaware of his own thinking as a subjective process separate from the objective world - "the possessor of a primitive intellectual innocence in spite of a deceptively mature facility in grammar and speech."

At five also, in personal social behaviour, a child is ready to fit into a simple type of culture, he has a certain capacity for friendships, his emotional organisation is still limited, however, by self-engrossment - but he can display in simple situations seriousness, purposefulness, persistence, pride in accomplishment and satisfaction in artistic production.

3.8 LANGUAGE DEVELOPMENT

Bühler (1935) studied the whole range of development from birth to maturity, documenting the mile-stones of physical, psycho-sexual and intellectual development. The latency period (i.e. the pre-puberty stage of growth) was marked out as a special period when the learning of basic techniques in reading, number and spelling was at a peak facilitatory stage. This "critical period" coincides with the traditional primary stage of education and it will be seen in Chapter 4 how maximum use can be made of this rule - learning potential for internalising regularities of language and number.

Also beginning his work at this time was another Continental developmentalist, Jean Piaget. His interest was in the sequence of intellectual development whereby a child progresses from understanding his environment in sensori-motor terms only (from approximately 0 - 2 years when intellectual growth is by perception and movement) through reasoning from a concrete stimulus-bound "here and now" mode of thought (2 - 11 years) to a formal reasoning ability directly linked to a logical causal system. In this third and formal stage hypotheses can be formed and tested and the ability to think in abstract symbolic terms becomes possible. This last stage roughly corresponds to a chronological age of thirteen or fourteen. Piaget is not concerned, however, with individual differences linked to mental ages, but describes general developmental sequences common to all children. His critics, amongst them Vernon (1956), question the arbitrary ordering of stages and maintain that even very young children can reach a level of abstract reasoning in a task familiar to them, e.g. building with bricks. Other critics emphasise that the achievement of specific maturational levels can be hastened by appropriate instruction in the environment, especially in the areas of conservation of mass, volume, capacity, space, etc. Piaget (1973) postulated that this type of learning by a process of assimilation and accommodation establishes the instrinsic conditions for transfer of learning generalisation and concept formation. The development of logical reasoning in the growing child is highly dependent on the experiences gained from the environment. In the sensori-motor period (approximately the first two years of life) the child by manipulating objects "eventually comes to regard himself as an object among others in a universe that is made up of permanent

objects (that is, structured in a spatio-temporal manner and in which there is at work a causality that is both localised in space and objectified in things" - a practical universe. Through these internalised experiences he develops a perceptual causality. At the end of the sensori-motor period a function appears that consists of the ability to represent something by means of a "signifier". Language, postulates Piaget (1973), is one of these signifiers (along with mental image, symbolic gesture etc.). It enables behaviour responses which imply the representative evocation of an object or event not present. Language increases the powers of thought in range and rapidity and can represent simultaneously all the elements of an organised structure. It provides the means of detaching thoughts from actions; and it has been elaborated socially. The power to represent thought in language develops from the ego-centric stage of"collective monologues", (addressing the material, and assimilation to the child's own action), to the socialised, operational level dominated by assimilation to the general co-ordination of action. In practice this representational use of language from syncretistic (global, non-analytic, without formal logic usage), to levels of formal logic, develops throughout the primary and secondary stages of education. It could presumably be understood to form the underlying frame of reference upon which the learned verbal activities of reading, writing and spelling will depend.

Bruner (1964) postulates a tri-partite sequence of development through sensori-motor, iconic (pictorial, graphic perceptual) to final symbolic representation of events. These according to Bruner are the developing techniques by which man represents and structures the regularities in his environment. He is especially interested in the transitions from one stage to another and quotes experiments which demonstrate how the growing use of language enables the child to gain insights into logical reality. Bruner describes an experiment in which children between the ages of 5 yrs and 7 yrs handle a double classification matrix. The materials of the experiment were nine plastic glasses, arranged so that they varied in three

degrees of diameter and three degrees of height. After preliminary familiarisation with the material, the children were asked eventually to reproduce the experimenter's pattern when it was transposed laterally. The three age groups varied in their ability to perform the task - the 7 year olds succeeding in the main but hardly any of the youngest children.

"Now consider the language children use for describing the dimensions of the matrix. Recall that the children were asked how glasses in a row and in a column were alike and how they differed. Children answered in three distinctive linguistic modes. One was dimensional, singling out two ends of an attribute - for example, "That one is higher, and that one is shorter". A second was global in nature. Of glasses differing only in height the child says, "That one is bigger and that one is little". The same words could be used equally well for diameter or for nearly any other magnitude. Finally, there was confounded usage: "That one is tall and that one is little", where a dimensional term is used for one end of the continuum and a global term for the other. The children who used confounded descriptions had the most difficulty with the transposed matrix. Lumping all ages together, the children who used confounded descriptions were twice as likely to fail on the transposition task as those who used either dimensional or global terms. But the language the children used had no relations whatsoever to their performance in reproducing the first untransposed matrix."

Inhelder and Sinclair also report that confounded language of this kind is associated with failure on conservation tasks in children of the same age.

In Russia, Vigotsky (1934) demonstrated by a neat experiment how children were able to categorise varying sizes and colours of shapes by a symbol system of previously meaningless morphemes. The use of language-forms enabled them to develop concepts and categories. His compatriot Luria (1959) describes a twin-study in which a previously linguistically retarded child of 4 years was given a specially devised teaching programme of language experience. The one twin was exposed daily to meaningful words and sentences, first in a receptive capacity and eventually in expressive verbal exchanges with the teachers. After some months this twin was compared with the "control" twin who had received no special teaching. Not only was there a dramatic improvement in the ability to use language meaningfully, but also in the ability to form

concepts in the "experimental" twin; whereas the "control" twin was still linguistically retarded.

3.9 RECENT DEVELOPMENTAL STUDIES

What motivates a child to acquire this communication skill of language if, as Smith (1971) writes:

"a child can get everything he wants without speech"?

Smith gives a psycholinguistic analysis of reading and learning to read and is the most recent account of developmental approaches to the acquisition of language skills. This author echoes Bruner when he writes:

"his (the child's) life from the time of his birth is a constant endeavour to impose regularity and predictability on the world and the only way he can do this is to develop rules that will reduce the load on his memory.....the dramatic discovery that words can be combined to form meanings not expressible in existing words must be a great relief for the infant's memory".

As described in a previous section, researchers in America give two categories of word-class used by infants during the second year of life. These are the so-called pivot class and open class. They are not imitations of adult speech but unique expressions to meet the child's particular requirements and represent meanings which he needs to express. An example of pivot class would be "all-gone". In this most economical system devised by the child, the pivot word "all-gone" can be used with open class "daddy", "sticky", "bye-bye", "baby", "milk", etc. and enable him to convey numerous meanings from a vocabulary of two or three hundred words. He does not use them at random, but in accordance with the rules he develops for himself. It is claimed that all children go through the same first rule stage and that the acquisition of the rule is one of the universals of language development in children. Smith (1971) writes:

"The child has rules for learning rules and he tests to see which particular rules apply.....the same kind of argument may be applied to reading - that basically a child is equipped with every skill that he needs in order to read and to learn to read; all that he needs to discover is the particular rules that apply."

This last statement supports the repeated contentions of this thesis viz. that as teachers we cannot avoid the responsibility of defining the particular rules of our language, especially spelling and syntax, and presenting them in orderly well structured schemes to the learner; and that the child with language difficulties, especially dyslexic difficulties who cannot easily derive the regularities because of underlying confusions will need much over-learning and over-teaching of these very rules.

These key figures in the history of experimental and developmental psychology have blazed a trail for many subsequent research students to follow. Their hypotheses have been tested by numerous workers in Universities, hospitals, clinics and colleges of education. A vast body of information is accumulating in support of the dynamic interactive theories of child development. It is commonly realised in education and psychological disciplines that many variables, both from the environment and from genetic-disposition, intereact to influence the readiness stages in which are acquired the skills transmitted by the culture in which the child finds himself. Learning to read is far more than the simple stimulus-response situation envisaged by those hopeful advocates of universal literacy in 1870.

3.10 PSYCHOLOGY, EDUCATION

The educationist's contribution to the growing awareness of the complexities of development and of learning to read was represented by a comprehensive American publication "The Improvement of Reading" by Gates (1935). Reading it again recently, over forty years after it was originally written, one is again impressed by the authority and depth of its teachings and dismayed by the apparent slowness of the impact of its message on the practitioners of reading teaching. Its relevance to present day illiteracy problems is evident from

a brief glance at chapter headings, e.g. "General Characteristics and Causes of Reading Difficulties"; "A Brief Sketch of the Nature and Development of Reading Abilities"; "A Survey of Intelligence, Vision Hearing and other Factors which Influence Reading"; "General Characteristics of Classroom Instruction and Remedial Instruction"; "A Brief Sketch of a Program of Testing and Diagnosis"; "Diagnosis and Development of the Left-to-Right Direction of Attack Word Perception"; "Diagnosis and Improvement of the Range and Level of Comprehension"; "Instruction for the Extreme Disabilities and Various Types of Handicapped Pupils".

In every decade since this seminal book there has been published some treatise on reading disability - Burt (1937), Schonell (1945), Daniels and Diack (1954), Vernon (1957), Malmquist (1958), Moyle (1968), Morris (1970) and Smith (1971). Morris (1970) describes the incidence of illiteracy in present day child population and reiterates once more the possible causes. Tansley (1969) discusses some of the barriers to learning and describes possible techniques of remediation.

In addition to these educational tests on the nature of reading, many admirable reading schemes have also been devised. Examples of these can be found in ~~Appendix 3~~ Archives: Aston[2]. In the late 1940's and early 1950's an educational psychologist, Schonell, for reasons more fully described in Chapter 1, Section 1.6, produced a lively set of readers called "The Happy Venture" series. It favoured the look-and-say approach to reading in that the text was immediately meaningful[1] and fulfilled the young child's pleasure in "story-sense". Stories were written using a controlled vocabulary of words well within the child's experience. Schonell criticised the "hog did a jog in the bog" approach to reading with its slavish adherence to phonetic analysis and synthesis at an inappropriate time in the sequence of learning and the developmental capacity of the child. Motivation by interesting content was allied to a carefully graded sequence of books and apparatus through which the child was guided by the teacher to achieve positive success and ultimate competence in reading, spelling and written English. The reading scheme was one part of a massive approach to the acquisition of the "second symbol system" which also included diagnostic and attainment tests (Schonell 1945), remedial schemes and basic texts.

[1] Vide references to the Gestalt school earlier in the chapter.

After this, the 1950's saw a rapid increase in the publication of attractive, colourful reading schemes in which lively illustrations helped to add meaning to the text. Gates (1935) when discussing "reading readiness" describes the advantages of children who have had experience in looking at pictures and making interpretations from them. He writes:

"Modern books for teaching reading make great use of pictures, and the more advanced a pupil is in his skill in interpreting the pictures the more help he will get from them in his initial reading lessons."

The use of pictures also serves well as a transition from event to iconic representation to symbolic system and gives again meaning to the task, well in line with the theories of Piaget (1973) and Bruner (1964). Emphasis has also been on the arrangement of text on the page, beginning with a short line span, to include a single "thought-unit", gradually increasing the number of lines of text per page and reducing the number of picture mnemonics. Each stage is supplemented with the relevant lists of spelling patterns, that is the permitted digrams and trigrams etc. of the English language. A particularly good series of the 1950's was the "Gayway" by Boyce, with its clearly tabled lists attached to each book in the earlier stages. Boyce was herself an Infant teacher for many years and used her skill and "knowingness" about young children when writing new books. The writer has found that the frame of reference of the author is a pertinent aspect of each reading scheme. One compares the "Gayway" for example with the Royal Road Readers written by male academics and based on a logical 'phonetic ' scheme. The latter would appear to succeed with older pupils and is, the writer believes, often preferred by male remedial teachers.

Added to this plethora of reading books in the late 1960's and early 1970's are the programmed learning kits, the Language Laboratory teaching schemes, teaching machines, tape-recorders and videotapes. A selection of these will be found in Gillham (1974) & Newton (1974). It would appear that the ten to thirty per cent illiteracy amongst school children is not due to the lack of suitable reading material!

There is no doubt that the movement towards informality in teaching methods has generally increased during the last ten years. A survey by Goodacre (1967) produced a result showing thirty-five professed child-centred methodologies against fifty-seven curriculum-centred, out of the one hundred schools used in the survey. Of the former category, the informality ranged from no set scheme at all - the work centred completely round the on-going activity and need of the children - to eclectic methods combining phonic, look-and-say and sentence methods. Many schools also use a wide range of reading schemes, selecting judiciously for individual need and not committing their teaching to one specific method, as was often the case say, fifteen years ago. Even in some of the "formal" schools, acquisition of reading skills is reinforced by the more indirect methods of individually created booklets and language activities. The situation overall would appear lively, open to experimentation and providing freedom to select. Yet many teachers of young children are anxious and eager for some direction and structure amidst the conflicting hypotheses and models set up by the so-called experts and the charges of child-illiteracy by others. It is stated elsewhere in the present thesis, that the skill to be acquired is built on rules and regulations that most children at certain stages of development are predisposed to acquire quickly and effectively. Within a realistic social context therefore and an awareness of individual differences, well-prepared teachers could well have the confidence and authority both to know these rules and to teach them; and also to recognise the specific difficulties of others who are not predisposed to acquire the rules. Moyle (1968) in his most comprehensive book on the teaching of reading writes:

"It is suggested that a blend of direct and indirect methods of the scientific and artistic, of the creative and the mechanical in the appropriate amounts for the individual child will prove to be the best investment for future success."

If we trace through this chapter on the teaching and learning of reading we can examine once again the key factors in this road to literacy - or illiteracy.

3.11 SUMMARY

Catty (1933) reminds us of the philosophical, liberal approach to the nature of man; of the dignity of personal self that lies within each child and how education must seek to fulfill the potential of each individual. The experimental and developmental psychologists investigate more deeply the nature of the individual differences amongst children. Their researches support the philosophical concepts of child-centred education on more pragmatic grounds: that there is a readiness time when interaction factors of nature and nurture provide maximum facilitating conditions for the acquisition of such a task as learning to read. The educationalist brings practical class-room technique to bear on these issues.

"In a practical sense, a major cause of reading defects is the fact that teaching large classes makes adjustment to individual need difficult....."

".....immaturity due to limited experiences and educational contacts rather than to physiological or organic factors may be involved in various degrees in reading difficulty. Limited experiences in conversation, story-hearing, playing with pictures and picture books.... the modern policy is to determine as definitely as possible each child's status in the abilities and interests involved in learning to read and to provide definite instruction to improve weaknesses and deficiencies until the pupil is demonstrably equipped to learn....."

".....the teacher should understand the nature of the reading process."

".....the teacher should know how to adapt the materials and methods of instruction to meet precisely the individual needs, the strengths and weaknesses of each child."

(Morris 1970; Gates 1927)

A picture emerges of the writer's idealised setting for the beginnings of school-learning:

i) The key role of the teacher

One cannot over-emphasise the critical nature of the responsibility attached to the teachers of beginner-learners and the onus therefore on colleges of education. At this truly "critical period" attitudes

and habits are formed which can affect the whole life-style of the person; self-image, achievement or failure, value systems, responsibility or immaturity, literate or illiterate. Possessing a genuine liking, empathy with and respect for small children certainly; but also teachers equipped with a sound basic understanding of child development and the considerable body of knowledge available at this time; an awareness of all teaching techniques and an open-mindedness towards new ideas as they occur; but wisdom in selecting the appropriate. Lively creative ability to stimulate and motivate the multi-sensory channels of learning; resilience; enduring cheerfulness; a mature, philosophical outlook; rich in their own education. One has been fortunate enough to have met some such teachers.

ii) The environment

This place of transition from home to school must be compact enough to engender security, cheerful and gay to reassure, yet structured in its own way to present a place of learning; a purpose-built laboratory. Furniture, equipment lay-out all designed to foster a positive involvement in meaningful activity; child-centred and learning-oriented. There are many such classrooms in this country.

iii) The logistics

Half-day school only for the first term, preferably morning. Three hours separation only from the known, secure, mother-safe environment at first. There are valid physical reasons for this gradual introduction to a more demanding disciplined regime as well as emotional and psychological, as the next section will show. Included in this category is the all-important size of group. To quote Catty writing in 1933 once again:

"No one, unless she has tried, can fully appreciate how much more difficult it is to deal intelligently with a class of from forty to fifty children than one of less than forty. I have found from many years' experience that as soon as there are more than forty children in a room, the difficulty of treating the children as self-respecting individuals is increased enormously. Moreover the children not only want space for all free work, but also additional space in different

parts of the room for their special plays and occupation. In my opinion no group of more than thirty should ever be under the charge of one teacher and she should have a room no smaller than that in which we now place from forty to fifty children, and furniture so light and sensible that it can be easily moved, easily adapted for all the purposes that busy, active, natural children need."

This absolutely vital factor in setting up the conditions for the beginnings of school learning has been echoed over the last forty years with predictable regularity by educationists, psychologists, Inspectors of Schools and Ministers of Education. All concern with subsequent primary, secondary and tertiary education is meaningless without this condition for establishing attitudes, habits, motivations, and foundations of skills at this primal basic stage. To expect the nation's illiteracy to be solved by political dogma translated into so-called "comprehensive" schools without this critical period being resolved shows a criminal lack of responsibility towards the education of a democratic society, made worse by the continuing lip service paid to advice of the specialists.

A group of twenty, (at most) five-year olds enables the trained and educated teacher to observe and understand the needs of each child upon entrance. Social, emotional, physical and intellectual readiness stages will be apprised. In the field of reading it will be seen which children need pre-reading experiences of all kinds, including linguistic experiences in verbal exchange - which children are ready to begin interpreting the written grapheme from the spoken grapheme; and which children are ready for wider reading and a beginning in the synthesis and analysis of spelling rules. In the second term, therefore, teaching groups can be established at appropriate levels and full-time teaching begun. In other fields, diagnosis can be made of visual and auditory problems (e.g. high frequency deafness or difficulties in visual acuity); possible dyslexic tendencies noted, physical anomalies understood, referrals to specialists made if necessary for early prophylaxis; emotional anxieties monitored, if possible resolved; and constant co-operation with the parents maintained for mutual understanding. The observations will be made by the trained eye in an active, dynamic setting, in an environment prepared as a learning 'laboratory' concomitant with this stage of development. Hardly any of these types of school-beginnings are to be found.

The ensuing illiteracy is put at over ten per cent of the population.[1] This may be an under-estimate in this country, since it depends upon one's definition of literacy. Child (1971) estimates the American figure to be greater. She writes:

".....the percentage of children who are afflicted with dyslexia (i.e. reading failure) seems to be very much smaller in England than we feel it is in this country (America). This of course merely points to the fact that we recognise less severe cases as needing special instruction, not in order to prevent failure only but in order to help the children to reach their real potential instead of going through life handicapped by the difficulty."

But whatever the incidence, illiteracy has been the concern of a specific body of educators and psychologists for the last thirty years. The next section will describe the various causes of illiteracy as postulated by these professional workers in the field.

1. A survey of $6\frac{1}{2}$ year old children in a Midlands town (1974) revealed that thirty per cent of them had as yet acquired no reading skills - in spite of the fact that they had been in a place of formal education since the age of five, with the expectation of at least some competency.

CHAPTER FOUR

BARRIERS TO LEARNING TO READ

4.1 PSYCHO-GENIC FACTORS

Chapter three describes how the teaching of reading, spelling and writing came to be commonly regarded as a major event in the primary stage of education. Yet the acquisition of these skills upon which rests so much of subsequent learning is far from an automatic process. In spite of nearly a hundred years of compulsory education, incidence of illiteracy in children over the age of eight ranges from four per cent to forty per cent (Vernon, 1970; Golberg and Schiffman, 1972). During the last thirty years educationists, psychologists and medical practitioners have brought forward their theories in explanation of the phenomenon of reading failure.

Difficulties in learning have been attributed to five main causes: environmental, intellectual, emotional, physical and neurological. Inhibiting factors in these areas can be termed "barriers to learning" and can prevent the child from getting meaning from his school experience. Sometimes several "barriers" interact and form almost insurmountable difficulties for the child and the teacher. The writer has known cases in which children have started school from very deprived socio-economic home backgrounds, with slow-learning potential as well as some 'at risk' birth feature of motor or sensory deficit. The school has been crowded with over-large classes and constant staff changes together with a high proportion of young inexperienced teachers. When finally referred for specialist help at nine or ten - or even fourteen - years of age with little if any school attainment, a primary developmental difficulty of perceptual and motor confusion of a dyslexic-type has been also diagnosed.

These kinds of barriers will now be described in some detail.

4.2 HOME AND SCHOOL

Some of the initial school environmental problems have been described already in Chapter Three; physical stresses such as the size and character of school buildings and playgrounds; noise level; length

of separation time from home; different methods of handling by unknown adults; the sudden need to conform to new arbitrary discipline and the over-large groups in infant classes. The home environments of many children have not prepared the young child for this dramatic change in his pattern of living. Special reference was made in Chapter One to the acquisition of language as being a necessary prerequisite for later skill in reading. American studies of the "disadvantaged" child and the attempts to remedy this disadvantage by the "headstart" programme, highlight this type of deprivation and its implications for education. A research programme of a similar kind is proceeding in Birmingham[1] and also in Nottingham[2].

Hess and Shipman (1965) studied the language acquisition of children from varying socio-economic levels. They investigated the language used by mothers in preparing children for school. They noted the response to the question "Suppose your child were starting school tomorrow for the first time. What would you tell him? How would you prepare him for school"? The person-oriented mother who used elaborated verbal codes (higher socio-economic in this study) was informative, related the experience to familiar events, offered reassurance, described the school situation as one that involves a personal relationship between the child and the teacher and presented the classroom situation as one in which the child was to learn. The status-oriented mother (lower social class group) defined the role of the child as passive and compliant, central issues dealt with authority and institution rather than with learning, and the relationships were in terms of status and role expectation rather than in personal terms. Her message was general and vague, lacking information on how to deal with the problems of school except by compliance. The former mother was said to be instructive, the latter mother imperative. Data yielded by this investigation suggested that status-oriented children became authority-dependent, relied on concrete here-and-now evidence in solving problems and lacked foresight and consequential thinking in conceptualising an event.

1 WIDLAKE P. Birmingham Education Priority Area. Action/Research Project.

2 NEWSON J. & E. (1963) Patterns of Infant Care in an Urban Community (Work Ongoing).

Person-oriented children on the other hand were receptive to insightful learning, understood cause and effect and used language as a mediator of experience.

Apart from the more conceptual disadvantages of children deprived of early language experiences, difficulties can arise in early communication with the teacher for more pragmatic reasons. Children in North Country towns accustomed to the long ōo sound, find the short digraph in 'book', 'look' and 'took' in the pronunciation of many teachers an initial block to transfer from phoneme to grapheme; similarly with the short or long 'a' in 'grass', 'castle', 'basket' etc. In Birmingham the 'floi is in the skoi' and the final consonant of ing becomes k - somethink. In Nottinghamshire 'ask' can become 'ax'; 'where' - 'wheer'; 'nobody but' - 'nobbut'; 'taking' - 'ta'ein'; 'told' - 'towed'; 'since' - 'sin'. In the reading book the child will say "Good-bye Miss Brown", but little Alfie in Peckham who has come from a Day nursery will say "Ta-ra Nursie"; or the cake and sandwiches of the book picnic become a "jam-buttie" in Stockport. The writer was reproached by a five year old, also in Stockport, when, having become tediously long in explaining the task at the beginning of the hand-work lesson she admonished "Well cum on then, let's get cuttin!" In her reader it would have said "let us begin to cut the paper". These and many more dialectical assimilated language patterns represent the internalised schemata of young children entering school. If learning to read in early stages is to be meaningful, the perceptive teacher will help this transition stage from home language to that of school and books.

Another language barrier at the early school-learning stage is the overseas child's lack of spoken English experience. The last ten years has seen a great increase in the number of immigrant children in our schools - Serbo-croats, Cypriots, West Indians, Irish and Hindu, etc. Programmes of language-familiarisation are being developed to meet this problem. In the clinic one is faced sometimes by a situation typified in the following case history. Mia was a political refugee who became a Nurse in a London hospital

and subsequently married an English doctor. She was very anxious that her child should grow up speaking English, so deliberately avoided talking to her in her own native tongue. Many of the 'primary-bond' experiences of loving communication between mother and child, the singing of nursery rhymes, picture book stories and expressed tenderness were therefore not experienced, as Mia was not competent to fulfill these verbal exchanges in English, Ruth, the child, arrived at school practically a mute and was referred to the clinic as possibly autistic. The history was complicated by mother's loneliness and unhappiness resulting in very deprived social experiences of other kinds, but fundamentally there had been no opportunity for Ruth to internalise a language schema. Such barriers to the acquisition of receptive, spoken language are the precursors of later barriers to written language.

4.3 AUTISTIC CHILDREN

The term autistic was used in the previous paragraph. An autistic child has been described as a "non-communicating" child, but the term autism is used to describe many conditions subsumed under a general phenomenon of verbal-language breakdown. The following is a brief synopsis of the various theories prevalent today. For convenience it is included in this section of environmental barriers, but could equally well have been under the emotional or neurological headings. Autism is still something of a mystery, a rare and only recently recognised condition, often called 'Kanner's syndrome' after the man who first described it in 1943. It is a form of abnormal development in which the child fails to make normal relationships with people and often with reality as a whole, and so does not communicate or conform. He behaves in a bizarre fashion. His actions and emotions are inexplicable and he functions generally at a very low level, yet occasionally he shows behaviour which indicates that his potential may be a great deal higher than his normal performance suggests.

Creak (1961) lists nine diagnostic points of autism:

1) Gross and sustained impairment of emotional relationships with people. This includes the more usual aloofness and the empty clinging (so-called symbiosis): also abnormal behaviour towards other people as persons, such as using them, or parts of them, impersonally. Difficulty in mixing and playing with other children is often outstanding and long-lasting.

2) Apparent unawareness of his own personal identity to a degree imappropriate to his age. This may be seen in abnormal behaviour towards himself, such as posturing or exploration and scrutiny of parts of his body. Repeated self-directed aggression, sometimes resulting in actual damage, may be another aspect of his lack of integration (see also point 5), as also the confusion of personal pronouns (see point 7).

3) Pathological preoccupation with particular objects or certain characteristics of them, without regard to their accepted functions.

4) Sustained resistance to change in the environment and a striving to maintain or restore sameness. In some instances behaviour appears to aim at producing a state of perceptual monotony.

5) Abnormal perceptual experience (in the absence of discernible organic abnormality) is implied by excessive, dimimshed, or unpredictable response to sensory stimuli - for example, visual and auditory avoidance (see also points 2 and 4), insensitivity to pain and temperature.

6) Acute, excessive, and seemingly illogical anxiety is a frequent phenomenon. This tends to be precipitated by change, whether in material environment or in routine, as well as by temporary interruption of a symbiotic attachment to persons or things (compare points 3 and 4, and also 1 and 2).

(apparently commonplace phenomena or objects seem to be invested with terrifying qualities. On the other hand, an appropriate sense of fear in the face of real danger may be lacking)

7) Speech may have been lost or never acquired, or may have failed to develop beyond a level appropriate to an earlier stage. There may be confusion of personal pronouns (see point 2), echolalia, or other mannerisms of use and diction. Though words or phrases may be uttered, they may convey no sense of ordinary communication.

8) Distortion in mobility patterns - for example

a) excess as in hyperkinesis
b) immobility as in katatonia
c) bizarre postures, or ritualistic mannerisms, such a rocking and spinning (themselves or objects).

9) A background of serious retardation in which islets of normal, near normal, or exceptional intellectual function or skill may appear.

The four major theories attribute the cause to emotional factors, physiological factors, coincidence causation, the autism-schizophrenia relationship and ethological theory. The emotional causation theory has a Freudian basis, considering that the autism stems from a failure in the mother-child relationship. If the child is unable to make a satisfactory primary bond with his mother, he is unable to relate to other people and also fails to develop a sense of his own "self". He is therefore unable to discriminate and lives, in Anthony's (1958) phrase "in the world of the young infant set in the twilight of consciousness". Anthony postulates that there are two types of autism: primary autism, which is evident from birth, and secondary autism, which appears later in infancy. He describes the child as a "self" surrounded by a permeable barrier. If the child has a warm stimulating mother, he develops a barrier which is thin enough to allow stimuli to penetrate, but as at the same time thick enough to prevent complete bombardment of the self by absorbing a certain proportion of the stimuli.

In primary autism, the child develops an abnormally thick barrier, so that very few stimuli penetrate and evoke a response. Anthony suggests that the mother allows this to happen by failing in her role and providing the child with insufficient stimulation. Instead of being warm and loving, she is rejecting and uninterested. Thus the barrier is not diminished by the mother actively stimulating the child and evoking responses and he becomes hypo-sensitive.

In secondary autism, the child becomes hypersensitive, i.e. his barrier becomes abnormally thin. This can be the result of maternal overstimulation and over-protection in the first year and leads to the child having no effective barrier against his environment. O'Gorman points out that a normal adult must ignore ninety per cent of all stimuli ninety per cent of the time in order to organise his perception and respond to the environment. In the case of the secondary autist, such selection is not possible, and he is subjected to a chaotic bombardment by his environment. This type of autism does not become apparent until at about three years. Before this, the child is functioning well, but regresses as he receives more and more stimulation.

Therefore, in both cases, the mother's behaviour towards her child causes abnormal psychological development and results in the child finding it very difficult, if not impossible, to differentiate between "self" and "non-self". From this are developed the bizarre behaviour and failures in perception, and the failure to relate. Some physiological theories suggest that a central nervous system abnormality causes autism. Hermelin (1967) places the abnormality in the dominant hemisphere (language involvement) and Hutt (1967) and Rimland (1964) both suggest the reticular formation as the location. Hutt and Ounsted (1957) hypothesise that autism is based on over-arousal of the reticular formation - this would explain the difficulty of attracting the autist's attention - he is continually in a state of "startle" and so seeking ways to reduce his arousal state. The ways he finds are visual avoidance, ritualistic behaviour, mannerisms and an insistence on the sameness of the environment. Birth trauma is sometimes blamed for brain-stem abnormality. One advantage of these neurological theories is that no blame is attached to the mother to cause guilt feelings and anxiety - as the "refrigerator-mother" type of theory often does.

"Coincidence" causation theory suggest that autism results from a child with a physical predisposition being subjected to a specific damaging environment (Kanner, 1949). Kirk (1968) states that if a child has an unrecognised defect of this kind, his behaviour seems strange and will not elicit many parental rewards. He will not learn what is expected of him, the parents will become upset and give their unresponsive child fewer rewards and a vicious circle of rejection is set up.

The autism-schizophrenia controversy debates whether the condition is one of childhood schizophrenia. O'Gorman (1967) feels that there is a continuum of childhood psychosis, where Mosse (1963) takes the opposite point of view since, she says, true schizophrenia occurs only during or after adolescence.

Latest theories from developmental psychology take their cue from ethology. If at a critical period, i.e. in the neonate stage and the weeks directly following, the baby does not manifest the behaviour forms of clinging, crying, following with the eyes, etc., reciprocal maternal tenderness is not released in the mother and the establishment of a warm mutual primary bond is not possible, affecting all future relationships. The failure of the baby to give these behaviour patterns may be due to bio-chemical abnormalities.

Whatever the cause of this non-communicating condition in a young child, the barrier against learning is firmly erected, and the teacher in the class-room will find the problem a most intractable one. It has been found possible, however, by the writer (Newton, 1972) to break through the barrier. Working in a clinical one-to-one relationship, supported by home and school and teaching in a therapeutic yet firm framework, it was found possible to transmit both written language and number skills to a previously very disturbed boy. The four main criteria were: avoid institutionalisation; regard the boy as "ordinary" as possible and anticipate an "ordinariness" of response in return; present an interesting, lively yet structured teaching programme, emphasising the task to be done; and offer a warm, safe, mutually respecting relationship.

4.4 INDIVIDUAL DIFFERENCES IN INTELLIGENCE

To a teacher, even in these egalitarian days, it appears that some children are "more equal than others". There are widespread individual differences in developmental "mental ages" amongst the large groups of children comprising the entrance classes. This "intellectual" barrier has been referred to in the previous chapter. It will be recalled that Binet's seminal work on intellectual assessment was set in train by the concern of the Parisian School Authorities over the non-attainment in the beginning stages of school learning.

A proportion of these beginners then will not have reached the readiness stages for formal learning described in earlier chapters. Some will be neurologically and intellectually equipped "to make

discriminative responses to graphic symbols and decode the symbols to speech". (Gibson, 1965).

Yet others will be ready to explore fully not only the phonetic and syntactic levels of reading, but the ultimate semantic stage when meaning, information and pleasure are derived from the written word.

Particularly in large groups, the barrier for the slow-learning child is in the descrepancy of his own inadequate potential and the expectations of the system. The difficulty does not lie simply in understanding the concepts of words, but in utterances. At five years the slow learner will respond with echo and with repetition: "Can you see the tulips?" - "Tulips"; "Aren't they a lovely red?" - "Red."; "This building is where the fire-engine lives." - "Fire-engine."

The fast learning five year old develops the narrative form:
"I went to the tulip festival in Cannon Hill Park. We saw Dutch ladies...."
"When the water goes through the hose it grows fat and strong and can knock a man down."

The former child needs opportunity for continuous experience in verbal exchange at increasing levels of complexity (McCarthy, 1954; Luria, 1959). This experience is again difficult in circumstances of formal teaching in large groups. But it is vital material for the internalised schema:

"the expectancy or anticipation which enables such experience entering consciousness to be charged with the integrated totality of previous relevant experience. (Vernon, 1964).

The slow-learning child needs extended practice time at each stage of language-reading competence, beginning with an acquired proficiency in "oracy" (Wilkinson, 1964). Gradually the spoken word translates to the written word, exemplified in the type of classroom environment described by Catty (1933). The pace of learning is much slower, a

greater variety of experience is needed at each new stage with repeated reinforcements and the grading is much less steep; every achievement is recognised and valued equally with the more spectacular successes of the fast-learning child.

In a large beginner group, the intellectually able child can also become a problem. Maintaining interest, motivation and a continuity of appropriate productive learning needs a perceptive and lively teacher to present a constant flow of adequate stimuli. Displacement activities can vary from withdrawn day-dreaming to disruptive behaviour problems if these more advanced intellectual needs are not met; or at best a docile child can engage unproductively on repetitive lower-level tasks. A conforming child who <u>appears</u> busy is often valued in a large class. It is not uncommon to meet a child in the guidance clinic who has been referred from a deprived socio-economic area school for non-attainment and behaviour disorders, and discover that his I.Q. range is from 130 - 140. This true potential has been masked by the expectations engendered by a generally depressed functioning level - teacher responds to a perceived ability rather than a true ability. He is unable to express the lack of meaning in the situation in sophisticated verbal terms and his frustration finds sterile and unproductive outlets. He is unable to derive meaning from the linguistic cues around him owing to his own ill-prepared language schema. In a small group under the eye of a perceptive and intelligent teacher his dilemma would be observed and material appropriate to his intellectual capacity could be provided at a level concomitant with his language experience. His own powers of insightful learning would do the rest and he would be regarded as the truly able person he is. Another problem faced by some children is in the expectation of parents. A boy of 10 is referred for treatment for pre-delinquent behaviour. The case-history reveals that the parents are educated members of professions and that other children in the family are intellectually able pupils at Grammar School. However, on the Binet type intelligence test, this boy may achieve a barely average mental age, totally in accordance with poly-genetic probability. His slower reactions and lesser achievements have been misunderstood by the parents, accustomed to children whose intelligences matched

theirs. He is thought to be lazy, obstinate, obstructive and is treated as such. Reactive behaviour forms eventually develop. Other children, in not such extreme cases, are made aware of somehow failing their parents, and develop anxiety syndromes, undesirable behaviour patterns and emotional disturbances. Other children, coming from well endowed educated home backgrounds develop mature standards of verbal ability in oral situations. As they are also likely to be socially competent, a spurious impression of precocious intellectual ability is given, both to parents and teachers. This specific verbal facility can mask an otherwise slow or average learning potential. Yet the expectation is of a high intelligence level. Impossible assignments of work can be presented, resulting in failure to learn and eventual emotional disorders.

The slow-learning child again might be still at the "sensori-motor" stage of learning upon arrival at school. To enable him to fulfill the requirements of this stage adequately, mobility of movement and appropriate handling materials must ideally be provided. Understanding and insight will be facilitated by relevant exchange of verbal interpretation with the teacher, which in its turn will transfer to the written word as "pre-reading activity". Barriers to this type of experience in the initial stages of learning are again over-large groups in under-sized class-rooms.

The concept of underlying general ability and individual differences in its incidence is a key feature in appropriate educational opportunity at every stage of school life. It is a fact of life for every teacher and just cannot be dismissed by any political dogma or academic controversy. At this time, the topic has received new impetus from the recent publications of Jensen (1969) and Eysenck (1971). Developmental psychologists and educationists seek to present a balanced outlook on this recurring nature/nurture controversy (Anastasi, 1958). Their standpoint bears repetition, that the individual inherits a certain constitution which sets the limit on intellectual potential but that the peaks of this limit can be realised only by exposure to the most propitious environmental circumstances, and can be disastrously depressed by unfavourable environmental circumstances. The innate

efficiency is probably largely a property of the central nervous system, as hypothesised by Wundt (1912).

4.5 MALADJUSTMENT

Several references have been made to emotional disturbances following upon learning difficulties. They can also precede the learning difficulties. There appear to be three critical periods of a child's school career when he is especially vulnerable to emotional stress. For boys, school entrance and in some cases transfer to the secondary stage, and for both boys and girls the period of adolescence. Even without partisan allegiance to psycho-analytic theory, in cultures where the small family unit is the primary social group it can be seen that tensions of jealousy can arise in the immature developing personalities of children. Stated in classical terms, the two to three year old boy's attachment to his mother and consequent jealousy of the father, and the sibling rivalry between other young members of the family. A child who is late in resolving this stage of psychological weaning from the mother and identification with father could arrive at school at the statutory age of five years extremely threatened by sudden separation. A boy who has still not resolved the stage when transfer to the more masculine world of the secondary school can be so threatened as to produce symptoms of school-phobia. The anxieties can be seen in some of the behaviour patterns described in the last chapter - enuresis, frequency, withdrawal, regression to earlier forms of behaviour, etc. This archetypal situation of "starting school" was experienced by the writer, not only as a teacher faced with the task of laying down foundations of cognitive learning in others, but as a mother whose own son shared the common experience. There were seventy parents and children in the hall of the local primary school. Over a period of one and a half hours we were summoned separately in alphabetical order to the Head Teacher's rostrum and from there directed to the child's new class. We were near the end of the list and as time went on the bleak unfamiliarity of the place and the persons gradually

reduced the erstwhile eager, open, curious, intending beginner to a silent, tense, dependent and very young child. Eventually he joined his class of forty-five other beginners in the formally arranged class-room and I wondered if the young teacher would manage to remember his name for the rest of the day - could it be nearly forty years since Catty had laid down the blue prints for "The Education of Young Children" (1933)?

His peers were well endowed children in the main, without the more severe deprivations and stresses faced in other areas yet one remembers the comments of other mothers sharing the strange fellowship of waiting together at the school gates for our children during the first weeks: "John is so tired after school, he just lies down in his gabardine on the rug in front of the fire and goes to sleep for an hour and a half"; "Anne has started sucking her thumb again"; "Billy has wet the bed every night this week. I cannot understand it, he has been dry since he was two"; "David has turned so aggressive with his little sister, if I am not there he pinches and hits her, he used to be so loving"; "Robert has started having temper tantrums again if he cannot have just what he wants at home"; "Sally was always taught not to take other peoples' things. On the very first morning someone took all her new crayons and she has cried every day"; "Stephen is sick every morning before we set out"; "Christopher has completely regressed in his speech habits, he has never used baby-talk, but he does it all the time now. He is less fluent than his baby sister"; "Brian has had raging ear-ache every night this week"; "I cannot understand why Shirley doesn't want to come to school she was longing to start".

With the help of these concerned and informed mothers, the valiant efforts of the teachers and the resilience of the children, these difficulties are lived through and adjustments by and large are made. The nature of the adjustment is, however, dependent on so many factors. In some areas, with a more favoured endowment the adjustment will be in the main positive, healthy and productive and realistic

involvement in the life-situation will develop. The barriers and maladjustments arise when external support or internal vulnerability are added to this stressful early experience. In the two conditions cited it will be seen that ANXIETY is the underlying barrier to the free acceptance of this new situation of formal learning. Emotional difficulties in young children can be quite simply described as anxiety difficulties. The perceptive teacher of a small group, attending school initially for only half a day will be aware of all the possible difficulties, and be able to support the beginning learner whilst he makes his own robust adjustment to the new situation. Learning will follow as positive motivations develop.

It has been described (Peel, 1965) how even children entering school from so-called stable homes have anxiety-difficulties to face. In many families however, inter-personal stresses, illness, death of loved ones, rejections, jealousies and separations can have contributed to a pre-school background of insecurity. One common syndrome in clinic experience is the boy of five who starts school at the same time as a new baby is born to the mother. If other factors are also impropitious in the family constellation, the boy suffers a double rejection. He enters school without adequate internal security to withstand the perceived threats in the new situation. Anxiety blocks receptivity to new learning and he is unable to involve in the acquisition of early reading skills. According to his temperament he will withdraw, regress to temper tantrums and aggressive behaviour towards others, refuse food, develop enuresis, or in extreme cases encopresis. Enuresis can be a reactive behaviour pattern in extreme anxiety whereas encopresis is considered to be a sign of aggression towards his mother. Nail biting and day-dreaming are other reactive behaviour patterns. In a large class the withdrawn quiet child is often missed by the busy teacher as being in need of special help and can be referred to the specialist as late as seven or eight years or even older as a non-reader. In a Canadian film made some years ago and called "Shyness", different patterns of withdrawn behaviour were depicted in the school setting. One boy was intellectually mature and had developed what was for him a perfectly valid life-style of quiet, scholarly, "bookish" behaviour; another boy had experienced the transitory rejection syndrome similar

to the above description but the third boy was seriously disturbed and needed very special help. The teacher needed time and opportunity to diagnose these different cries for help.

Robertson (1968) and Bowlby (1958) have spent years examining the consequences of separation traumata in young children and have produced a series of films showing case-histories of families thus affected. "A two-year old goes to Hospital" was one of the earlier films and describes the severe emotional trauma suffered by a child of this age group after a forced separation from his mother. A key feature is the regression to earlier forms of behaviour, especially in language. Similar events have been seen in Clinic referrals where an echoing feeling of threat and panic is evoked in such a child starting school when he is again suddenly separated from his mother. His linguistic ability regresses and he is unable to respond to the new symbolic learning demands. Their most recent film "John" (1966) won an award at the Cannes film festival and is concerned with the effects of brief separation when a boy of stable and loving background is abruptly separated from his parents and placed in a day nursery while his mother enters hospital to have a second baby. The film graphically traces the developing distress of the boy and his eventual withdrawal from even the safe relationship he had previously known with his mother.

Bowlby (1958) has made a notable contribution to the understanding of dynamic developmental theories and the emotional stresses consequent upon unresolved critical periods. The maladjustments of children who are placed in care whilst very young and exposed to an ever changing pattern of institution, fostering, adoption, etc., without ever establishing a unique primary bond are documented by Pringle (1954, 1965) and an integral part of her work is the concomitant retardation and failure in school attainment. It was whilst investigating the "young delinquent" that Burt (1937) came upon the incidence of illiteracy as a concomitant feature of a globally deprived background. We shall see in a later chapter how this work was of critical significance in establishing a pattern for remedial education for the

failing child. So many of these emotionally disabled children eventually reach the school psychological services that it is still commonly held amongst educational psychologists that together with socio-economic poverty, emotional trauma causation is the main contributory precipitating factor for reading failure in school. Newton (1972) describes some such actual case histories and subsequent remedial treatment.

We shall see how these theories favour the environmentalist view of causation of illiteracy, so prevalent in the 1950's and 1960's when many educational psychologists and remedial teachers were being trained.

Referring back to the first chapter of the thesis, one is reminded again how emphasis on such extrinsic, secondary causes of reading disability has overwhelmed educational practice during the last twenty-five years. The next chapter looks at some of these neglected areas and points the way "towards diagnosis".

4.6 INTRINSIC, NEUROLOGICAL

The environmental causes discussed in the previous section are indeed potent and have the advantage that tangible forms of treatment, therapy and remedial education can be attempted. To attribute all failure to extrinsic causes however, has been the source of the controversy between the medical and psychological professions already mentioned. Burt in particular objects to the neurologist's use of the term 'word-blind' to describe reading failure, with its implication, as with colour-blind that nothing can be done; it is an irretrievable, irreversible condition. However, as will be seen, to discard a concept of possible neurological predisposition to failure because of objecting to the term used to describe it is in truth throwing the baby out with the bath water. It is highly probable that some children enter school with environmental stress and a neurological predisposition to difficulties in learning to read. Indeed, in cases of neurological or biochemical defect it is by no means inevitable that the original condition will persist and prevent all cognitive development. Phenylketonuria (a genetic

defect) for instance can be treated if diagnosed sufficiently early and the mental defect which would otherwise develop is prevented from doing so. Great ingenuity is being used by teachers of cerebral-palsied children or children with visual and auditory abnormalities etc. to provide appropriate learning conditions and remedial teaching programmes. It would seem that the true role of the educator is to recognise and diagnose the specific difficulty and prepare the relevant teaching schemes rather than deny the existence of disability.

Before proceeding to review the neurological theories however, brief mention must be made of possible physical barriers to learning.

In the writer's model of the first school-learning environment it was postulated that in the small entrants group the perceptive teacher would be able to diagnose visual acuity problems and high frequency deafness before the onset of frustrations and the inevitable learning difficulties sequelae. The latter in particular is a possible cause of failure because of the dependence of the grapheme on the related phoneme, the usual source of stimulus being a woman teacher's voice; and also because it might not have been recognised as a difficulty in the home environment. In the writer's experience several of such children have been assessed as slow-learning and even defective as a result of a frustration reaction pattern of temper tantrums. Any suspected auditory problem can be referred immediately for audiometric testing. One also sees the child with a minimal biochemical disorder - the slow-moving, obese child or, conversely, the one who is hyper-active and disruptive to the group in his own restlessness. These children can now be helped by medication. On a more ordinary level is the under-nourished child, still a possibility even in a "welfare society". Changes in the EEG can occur after only five hours without food when the blood-sugar level of the brain is low, so a child who comes to morning school without breakfast will be at a disadvantage in his learning potential apart from the long-term effects of under-nourishment. As also will be the child who is in a constant state of fatigue due to lack of sleep from a variety of home based reasons - or due to a sudden spurt in growth rate. Asthmatic children too are vulnerable to learning stresses as are others with epileptic potential. Physical problems can be precipitated by

psychological pressures. As a teacher one is also concerned at the number of young children, especially boys, suffering from severe earache in the first years of schooling. All these potential physical needs demand insightful monitoring by the teacher, if maximum involvement in the learning situation is to begin.

We turn now to neurological barriers to learning. These barriers represent the intrinsic factors which are key issues in this thesis about dyslexia. Chapter 1 described some of the studies from neurology and neuropsychology which have direct relevance to primary reading difficulties. The reader is referred again to this chapter on central nervous system involvement in linguistic skills. The present writer believes that so much emphasis has been placed on psychogenic causes of reading failure by educationists and educational psychologists that primary neurological factors remain largely ignored in teacher training programmes. Teachers are ill-prepared therefore to understand the incompatibility which can exist between the nature of a formal symbolic system and the developmental pattern of the young learner. Learning is a property of the central nervous system. Events from the external world are recorded by the receptors of the human body e.g. eyes, ears, touch sensory etc. referred by neural pathways to the brain, there to be organised into meaningful patterns and transcribed when necessary into behaviour. The brain therefore, with its 10^{10} million cells (or neurons) and many millions of intercommunicating networks is the great encoder of experience. The association cortex is equipped with the power of integrating information from both the internal and external environments of men. The highest form of representation of experience is that of symbolic representation. It has been described earlier how language and reading are seen as the first and second symbol systems, forming internal models of experience that enable man to free himself from the here and now, associate an infinity of events into meaningful patterns, relate cause to effect, solve problems, make decisions and change his behaviour by systems of logic not possible in lower animals. Although there is vast redundancy in the brain, certain areas appear to be critical for the acquisition of perceptual, motor and symbolic skills.

Higher symbolic skills in particular need an integrity of neural function especially in the occipital, temporal and parietal regions. Neurological berriers to acquisition of the higher symbolic skills can be either of organic (often traumatic) or of genetic, constitutional origin. Because they have evolved late in the long evolutionary history of man, these higher association areas seem most vulnerable to traumata.

Marion Annett (1965) hypothesises that as spatial and orientation ability is a primary need of the organism for survival, a child damaged cortically will transfer spatial type learning to the dominant hemisphere, to the detriment of language development. Two American researchers, Kawi and Pasamanick (1959)[1] propose a continuum of reproductive casualty ranging from death in utero and in the neo-natal period to minimal cerebral damage resulting in minor behavioural dysfunction; reading disorders constituting a component of this continuum. They found that in 16.6 per cent of a series of two hundred and five children with reading retardation there had been complications during the mother's pregnancy (pre-eclampsia, bleeding or hypertension). They suggested also that asphyxia or prematurity were aetiological factors in the incidence of cerebral damage leading to reading retardation. At least since Stockard's (1921) work it has been realised that critical periods exist in development for satisfactory growth stages and that these periods relate to times of maximum tissue growth. It is now known for example that an attack of rubella in early pregnancy can put the foetus at risk. Chromosomal irregularities precipitate defective growth patterns at certain stages in pregnancy. Hyper-tension and even psychic stress have recently been diagnosed as possible causes for later developmental problems. A post-term baby suffers the risk of anoxia and subsequent lack of this vital nourishment to brain cells, which to not regenerate if they die off at birth. Symbolic learning potential can sometimes be diminished in such

1 See also Chapter 1

cases. Premature babies have in some cases suffered from hyper-oxygenation, resulting in retinal damage. Difficult birth can result in mechanical damage to parts of the brain cortex. In all these cases of "reproductive casualty", the cognitive, symbolic potential of the organism is put at risk. Some of the effects will only be seen during later stages of childhood and especially in the fields of language and eventually reading.

4.7 CORTICAL SPECIFICITY OF FUNCTION

It has been known for almost exactly a hundred years that disorders of language bear a special relation to damage to the left hemisphere of the brain and, indeed, to particular parts of it.[1] In 1861 Broca implicated the third left frontal gyrus as a "centre" for articulate speech, and although this localisation has been questioned it seems clear that damage to the more anterior parts of the hemisphere is likely to affect language predominantly in its expressive aspects. In 1874, Wernicke described a syndrome comprising defect in speech comprehension, use of wrong words in spontaneous utterance, together with defect in reading and writing associated with lesions of the left temporal lobe. Subsequently, cases were described in which defect in reading and writing might occur with little or no speech disorder, and even rare cases ("pure alexia") of defect in reading without defect in writing. These were for the most part cases in which the lesion involved the posterior parietal or occipito-parietal areas of the cortex, thus suggesting that the different aspects of language might be localised independently of one another in the cortex.

While modern opinion is divided as to the extent to which psychological functions can be localised in any very meaningful sense of the term, there is no doubt that symptoms of brain injury or disease do vary very considerably according to which hemisphere, and indeed which part of it, is damaged. In general, verbal and symbolic functions suffer principally from left hemisphere injuries and visuo-spatial functions from right hemisphere lesions. In the case of reading, failure to understand what is read results only from lesions of the left hemisphere though failure to scan lines correctly or to pass from one line to the next may result from spatial disorganisation

due to right hemipshere lesion. While brain lesions sustained in infancy do not always result in the same clinical picture as similar lesions sustained at maturity, minor defects of a "neurological" character are not altogether uncommon among children with severe reading difficulty and parents and teachers can be alerted to them. They comprise, in addition to those mentioned in Chapter 1, poor co-ordination or excessive clumsiness, difficulties in scanning a line of print consistently from left to right and a tendency to lose the place, difficulties in learning serial order, whether of letters within a word or of sentences or verses by heart, and relatively poor performance on either "verbal" or "non-verbal" intelligence tests, though seldom on both. Such anomalies have been described in Chapter 1 as "soft neurological signs", a term favoured by American specialists.

The task of the neuro-psychologist is to attempt to relate these behaviour patterns to underlying brain function. Present interest lies in the "two-brained" nature of man. Could specificity of function be located in this bilateral system? Has man evolved a uni-directional potential within this system to enable him to decode and encode a temporally ordered symbolic code? The writer returns to this theme of laterality, first described in Chapter 1as a possible theoretical framework for dyslexic difficulties.

4.8 IMPLICATIONS OF LATERALITY AND CEREBRAL DOMINANCE

The writer considers that the differentiation of function between the two hemispheres of the brain plays a key role in the acquisition of human skill. Referring back to Chapter 2 one is reminded of the arbitrary, symbolic directional constraints involved in the task of reading ..... symbolic stimuli. It has been mentioned earlier that Broca first put forward the view that both right-handedness and the lateralisation of speech are due to innate functional pre-eminence of the left hemisphere, which causes it to mature at a more rapid rate than its fellow. McCready (1910) thought that there must be a common

aetiological basis for dyslexia, congenital word deafness, delayed speech acquisition and stuttering, considering them all to result from incomplete cerebral dominance manifested in weak or inconsistent lateralisation. Orton (1937) supposed that the memory-traces or "engrams" corresponding to speech patterns are laid down in both hemispheres in the course of language development, but if left hemisphere dominance is imperfect, a kind of reciprocal inhibition of the activities of the two hemispheres takes place, giving rise to stuttering in speech and reversals in reading or writing ("strephosymbolia"). He claimed to find these phenomena in a large group of backward readers studied at the Greene County Mental Clinic in Iowa. He laid particular emphasis on the tendency to letter and word reversal, which in his view greatly disturbs the acquisition of series and produces great difficulty in reading as well as a tendency to mirror-writing. Indeed he described the ocular scanning of such handicapped readers at "looking at random". (Critchley, 1964) wrote:

"To a clinical neurologist certain functions are recalled which are commonly regarded as being parieto-occipital in character. The not infrequent conjunction of dyslexia with directional disorders and with spatial defects both of a personal and extra-personal nature may be cited as telling evidence. In so far as symbolic thinking is at fault, it is the parieto-occipital region of the dominant hemisphere which is under suspicion, that is if one can discern cerebral dominance at all in these dyslexic patients."

Ettlinger and Jackson (1955) using the Jasper-Raney Phi-test, which by comparing illusory movement of objects within the two homonymous fields claims to gauge occipital lobe dominance, found that dyslexics display no cleancut directional preponderance. This suggests a lack of one-sided occipital dominance which may well be the evidence of non-maturation. This state, they claimed, is often spoken of a cerebral ambi-laterality and is believed by some to be associated with an unstable cerebral organisation, one which is particularly sensitive to the effect of stress.

That both cerebral ambi-laterality and dyslexia are to be equated with immaturity of cerebral development is the view most widely held today among neurologists. Gooddy and Reinhold (1961) have

entertained the same notions of maturational lag but have expressed them in somewhat different terms. They stress the hypothesis that in normal circumstances asymmetry of the functions of the two cerebral hemispheres is established during early development and that this asymmetry of function is closely related to the performance of reading and writing. Children with developmental dyslexia, however, fail to establish asymmetric cerebral functions of the two cerebral hemispheres.

Josephine Semmes (1968) postulates differential functional areas in the two hemispheres. She suggests that in the left hemisphere there is focal representation whereas in the right hemisphere representation is diffuse. She proposes that focal representation of elementary functions favours integration of similar units and consequently specialisation for behaviours which demand fine sensori-motor control, e.g. manual skills and speech. Diffuse representation, however, may lead to integration of dissimilar units and hence specialisation for behaviours requiring multi-modal co-ordination such as spatial skills.

Bannatyne (1964) postulates that a good appreciation of spatial relationships demands a fairly well co-ordinated motor system involving both hemispheres of the brain and acute three-dimensional vision in both visual fields. This calls for the equal use of the visual areas of the brain in both hemispheres. This neurological state of affairs, i.e. the equality between the hemispheres, in people with a reasonable or high degree of spatial ability tends to make them ambidextrous and to make them scan the whole field of vision very rapidly in all directions as is necessary in a three-dimensional world. (Reading calls for a discipline of scanning in one direction only.) An appreciation of space in terms of survival value, particularly in terms of vision demands peripheral stimuli to be rapidly recognised and interpreted in both the left and right visual half fields and hence in both the right and left visual areas of the brain. Moreover, probably the two hemispheres work in terms of mirrored sensory and motor functions.

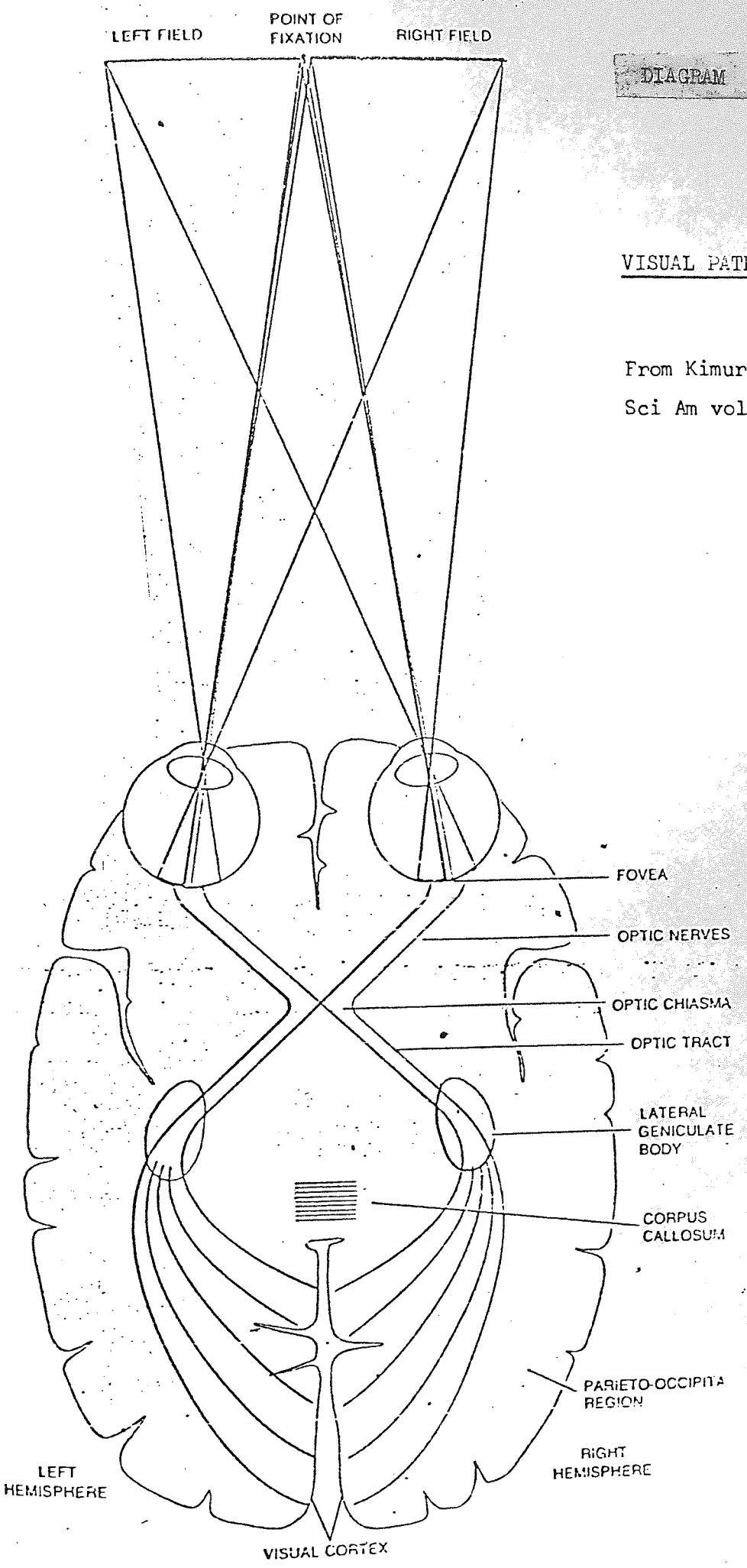
Although information from the right half fields of <u>both</u> eyes passes to the left hemisphere and from the left half fields of <u>both</u> eyes to the [illegible] recent evidence suggests that one eye assumes a

DIAGRAM 3

VISUAL PATHWAYS

From Kimura (1973)

Sci Am vol 228 Part 3 70 - 80



VISUAL PATHWAYS are completely crossed, so that when the eyes are fixated on a point,

dominance for a directional task such as reading. For left-right scanning movements, right eye dominance would be facilitatory. It is possible that people with partly lateralised motor control find it difficult to establish systematic left/right scanning and that people with strong sinistral tendency find it even more difficult, having a preference for right to left scanning. Again, following Orton's theory, that verbal "engrams" are laid down in both hemispheres, those laid down in the right hemisphere will be mirror-images of those laid down in the left hemisphere in whatever form they are encoded. In the fully left-brain-dominant individual, the "mirror-engrams" in the right hemisphere are inhibited or suppressed by those in the left hemisphere, such that reading and writing come under dominant hemisphere control and reversals fade out. Where there is poor lateralisation, either hemisphere may function to some extent in reading and writing (and perhaps in speech too), so that there will be confusion, reversals, mirror writing (and perhaps stuttering)[1] be it visual or auditory.

Goodglass and Quadfasel (1954) suggest that cerebral ambi-laterality is the rule in sinistrals, i.e. that speech is represented bilaterally and some aphasia is in consequence liable to accompany lesions of either hemisphere. Humphrey and Zangwill (1952) state that left-handedness does not imply strict specialisation. Humphrey (1951) makes the point that cerebral dominance either does not occur at all in the so-called left-handed or if it does occur, tends to be less well developed than in the general run of right-handed persons. He also postulates that cerebral representation of the language function in such cases is bilateral, at least to a greater degree than in most right-handed people. Evidence is also accumulating to the effect that so-called left-handed as well as less dominant right-handed people have, in fact, strong predispositions to ambi-dexterity. Genetic control of the process of lateralisation and cerebral functioning has also been suggested by Levy and Nagylakil (1971),

1. The writer acknowledges her debt to Professor Zangwill, Psychologgy Department, Cambridge University, for his invaluable help in the clarification of these theories.

but Lennelerg (1967) favours a developmental theory of cerebral organisation and of the relevance of the maturational process in general. Basser (1962) states that there is apparently a period in infancy when the hemispheres are still equipotential, that is with respect to language functioning and control. The dominance phenomenon seems to come about through a progressive decrease in involvement of the right hemisphere. But if the left hemisphere is not functioning properly the physiological activities of the right hemisphere persist in their early function. As the child matures, however, and language acquisition is possible, cerebral dominance manifests itself in the majority of children, states Basser; there appears a progressive shift of language function to the left hemisphere and a progressive decrease in involvement of the right hemisphere. Lenneberg concludes from these and other studies that the primary limiting factors for ease in first language acquisition are cerebral immaturity and general lack of maturation in infancy, and termination of a state of organisational plasticity linked with lateralisation of function in adolescence. Thus the critical period for language acquisition is seen to terminate at the age of puberty when the brain can be shown to have reached a state of maturity and cerebral lateralisation is "irreversibly established". The present writer considers that this might be generally the case, but from direct observation of many clinical cases of adolescent learning patterns together with reporting from other reliable sources there appears to be a maturation continuum with some individuals resolving cerebral dominance later than puberty and some probably not at all.

4.9 MOTOR DEVELOPMENT

Many studies of reading difficulty have in the past considered its relationship to left-handedness. (Clarke, 1957). The problem appears to be the validity of some of these findings owing to the difficulties of ascertaining by questionnaire - or even operationally defined tasks - the real nature of "left-handedness" as opposed to "inconsistent" handedness. The writers refers back to the findings of Zangwill and Humphrey (1971), on the lesser strict specialisation of so-called

left-handers - and also to the findings of Annett, Zangwill et al (1970) that 28 per cent of a large sample of people tested were ambi-lateral, some of whom appeared to favour the right hand more and some the left. (Table 6) The writer also finds in clinical practice that many subjects who profess themselves to be left-handed for writing, do in fact perform many tasks (e.g. dealing cards, peeling oranges, threading needles, batting at cricket, cutting with scissors) with the right hand. A developmental pattern of "handedness" as with "brainedness" also seems to occur. Palmer (1973) noticed the relative symmetrical movements of the extremities of infants; Gesell and Ames (1947) described asymmetric hand movements as developing out of the tonic neck reflex (an asymmetric posturing behaviour found in the young infant), but these were later seen to be unstable and readily submerged by symmetrical bilateral patterns. Subirana (1969) reviewed the differing opinions of several writers, most of whom he found, did agree that there is considerable instability of manual preferences before school age in most children though hand preference can appear as early as the first year of life. Sindall (1971) reported that:

"hand and foot preference usually seemed stable after the age of five years, as was eye preference, while ear preference may vary up to the age of seven".

Passion et al (1959) found that the frequency of strong predominating left-handedness and right-handedness increased with age and found some "oscillation of hand preference" between the ages of 5 to 7 years. Lenneberg gives the following summary and table, surveying the relationship of language development, cerebral dominance maturation and lateralisation of function. (Table 4)

Why should the easy acquisition of language skills depend upon this type of neural association and integrity in the one hemisphere? The theories of Orton and Bannatyne stress the underlying interference and confusion, resulting in reversal and mirror-imaging.

TABLE 6

SCHEMATIC SUMMARY OF POSSIBLE RELATIONS BETWEEN HANDEDNESS, CEREBRAL REPRESENTATION OF SPEECH AND HYPOTHESISED GENETIC FACTORS

A. Summary of the literature reviewed by Bingley (1958), Zangwill (1960)

1. Hand Preference	RIGHT	LEFT
usually described as	consistent	inconsistent
assessments of incidence		varying between 2 - 30 per cent
genetic model (Trankell, 1955)	rr + rl + ll	ll
2. Cerebral Representation of Speech		i RIGHT ii LEFT iii BOTH iv EITHER but not both

B. Annett, Lee and Ounsted (1961)

1. Hand Preference	RIGHT	MIXED	LEFT
expected to be	consistent	inconsistent	consistent
2. Cerebral Representation of Speech	LEFT	LEFT or RIGHT	RIGHT

C. Annett (1964)

genetic model	rr	rl	ll

D. Annett (1967)

Per cent in 7 samples N 1226	67.5	28.7	3.8
binomial proportions	r^2	2rl	l^2

Gerhardt (1959)[1] writing of arbitrary, ordered symbolic interpretation difficulties in pilots states:

"He (the pilot) would perceive a square, a house, a tree and the like with the same ease as others. Even though I have no difficulty in perceiving the forms in my environment, I may be confused or retarded when I get the task of seeing them in a special order, direction or sequence."

The high percentage of left-handed or ambi-dextrous subjects in the study of reading failure, described in Chapter 5, supports the already vast accumulation of clinical evidence for this phenomenon as a critical feature of dyslexia. Roberts (1956) makes pertinent reference to this puzzling inter-dependence when he says:

"The development of handedness and the development of laterality for language are phenomena which are not in direct relationship or dependence, but the preference of the left hemisphere for both indicates that some common factor favouring the left hemisphere must be responsible".

Another interesting related phenomenon is the high spatial ability often associated with subjects who are handicapped in a "verbal" society by low linguistic coding skills. Does an equivalence of hemispheric functioning predispose to superior processing of spatial-type information as suggested by Bannatyne (1964)?

In contrast to the difficulties experienced in coding arbitrary sequential symbolic material, as in verbal auditory abilities, evidence is accumulating to suggest that ambi-laterality predisposes to good visuo-spatial ability. Claims have been made that there is a significant disparity between the scores of the Verbal and Performance sub-groups of the Wechsler Intelligence Scale in the case of dyslexic subjects. Rabinovitch (1954) cited a large discrepancy (averaging 22.1 points in favour of the performance tests)

1. Chief Psychologist to the Norwegian Armed Forces, who has encountered the phenomenon dyslexia in left-handed and ambi-dextrous pilots who were vulnerable to critical incidents in flying accidents.

between verbal and performance intelligence quotients. Clinically the writer has observed the picture to be often one of predisposition to artistic design and graphic ability in the ambi-lateral poor reader. Clinical case histories[1] reveal an association between a retarded developmental pattern of linguistic skills and subsequent success in civil engineering, architecture, dental surgery, draughtsmanship, tailoring, design and medicine.[2] These histories also reveal genetic influences in the patterning of the various skills. It could be, of course, that a relatively superior visuo-spatial ability exists, due to the fact that language intelligence is depressed in many people with dyslexia, perhaps due to minimal impairment of left hemisphere functions and an enhancement of visuo-spatial ability due to ambi-laterality. Superior verbal as opposed to non-verbal, performance has been described in non-dyslexic left-handers and attributed to a suppression of development of visuo-spatial skill due to language being partly or wholly organised in the right hemisphere.[3]

4.10 SEX DIFFEPENCES IN LATERALITY

Bannatyne (1964) discussed the high male to female ratio (which may possibly be as high as 10 to 1) in dyslexics. He writes:

"One of the most important characteristics of dyslexia is difference in sex incidence. In severe cases the ratio may rise to ten to one and so there seems to be little doubt that genetic dyslexia is in some way a sex linked characteristic. Dyslexic boys in this genetic group do quite well in all those spatial tests which do not demand sequencing and their visual perception in terms of relationships in three-dimensional space is usually good. Their ability to conceptualise logically in terms of meaning is also usually quite competent. The main area in which they fail is in terms of linguistic or other types of automatic coding fluency. In fact arbitrary (that is 'non-logical') sequencing tests are especially difficult and in essence learning to read and spell are nothing more than arbitrary, irregular sequencing processes which in the average person rapidly become automatic with some training."

1. Research data, Applied Psychology Department, University of Aston
2. Ian Macfarlane-Smith of Garnett College has been researching into the possibilities of a specific spatial ability in man for over thirty years, using techniques of psychometric testing and factor analysis. His book on "Spatial Ability" (1964) pub. University of London Press discusses the underlying hypothesis and describes the work.

...tion from Professor Zangwill.

Clinical studies and evidence from research (Touwen, 1972) demonstrates the preponderance of left-handedness in males over females present in the total range from slight left-predominance to pure left-handedness. Handedness is usually considered a parameter of laterality to which other functions can be compared, and expressions of handedness and hand differentiation are considered as complex phenomena "rooted in more general aspects of motor and psychological development and cerebral dominance" (Gesell and Ames, 1947). Later researches investigate sex-differences in cerebral laterality of function. Kimura (1973) found males superior to females in certain visuo-spatial tasks - the males, with right hemisphere tasks, tended to have a greater left-visual field superiority for dot location and dot enumeration than females. She suggests that right hemisphere specialisation is more pronounced in males than in fameles and that such specialisation may sometimes be advantageous. McGlone and Davidson (1972) found that males usually performed better in a standard test of spatial perception involving the identification of a design after it has been rotated than females and that those females who performed poorly were those who showed some left-hemispheric specialisation for spatial functions. On the other hand, females tend to have greater verbal fluency than males. Dichotic listening studies indicate that speech lateralisation may develop earlier in girls than boys. This would support the developmental finding that girls on the whole are about eighteen months ahead in several aspects of maturation at the age of first school attendance and boys could be vulnerable therefore in the first stages of language learning - a highly significant factor in reading problems.

4.11 LATERALITY EVIDENCE FROM ANIMAL STUDIES

Dr J Noble (1966) of the MRC Cerebral Functions Research Group at University College, London, has recently been investigating "mirror-image" paradoxical perception in rhesus monkeys. In the experimental animal the optic chiasma was cut and the monkey, with one eye covered, trained to discriminate between two shapes that are lateral mirror-images

of each other. When the same monkey is made to use the "untrained" eye, it unexpectedly prefers the previously unrewarded shape. Because of the direct and indirect fibres carrying visual information from the retina to the cortex in normal monkeys, Dr Noble points out that the cortex of each hemisphere will have a different impression of an image. The two impressions will be mirror-images of each other and that if there is any conflict between images, the direct input from the striate cortex over-rides the indirect input. Monkeys with sectioned optic chiasmata and therefore no indirect input when using the untrained eye will opt for an object that corresponds with the transferred image which has been flipped over in a mirror-image fashion in the inferotemporal regions and matches the inverted direct image. It is postulated that the same confusion in interpreting symbols might arise in children whose cerebral dominance is poorly developed. One refers back to Orton's intuitive hypothesis from observation of children's mirror-writing and reversed reading in the 1930's.

4.12 TOWARDS THE PRESENT RESEARCH

The supporting neurological findings referred to above are taken from the most recent research programmes. One such research was undertaken by the writer in 1966 whilst working as a clinical remedial therapist with special reference in treatment to those language barriers described above as "psychogenic", attention was increasingly drawn to the other, neurological barriers. The next chapter describes what came to be a crucial stage in the understanding of the phenomenon of 'dyslexia' and which has ultimately led to the presentation of this thesis.

CHAPTER FIVE

THE EMERGENCE OF A PHENOMENON

5.1 THE BEGINNINGS OF CLINICAL RECOGNITION: A syndrome is perceived

5.2 EXPERIMENTAL STUDIES

5.3 DISCUSSION

5.1 THE BEGINNINGS OF CLINICAL RECOGNITION: A SYNDROME IS PERCEIVED.

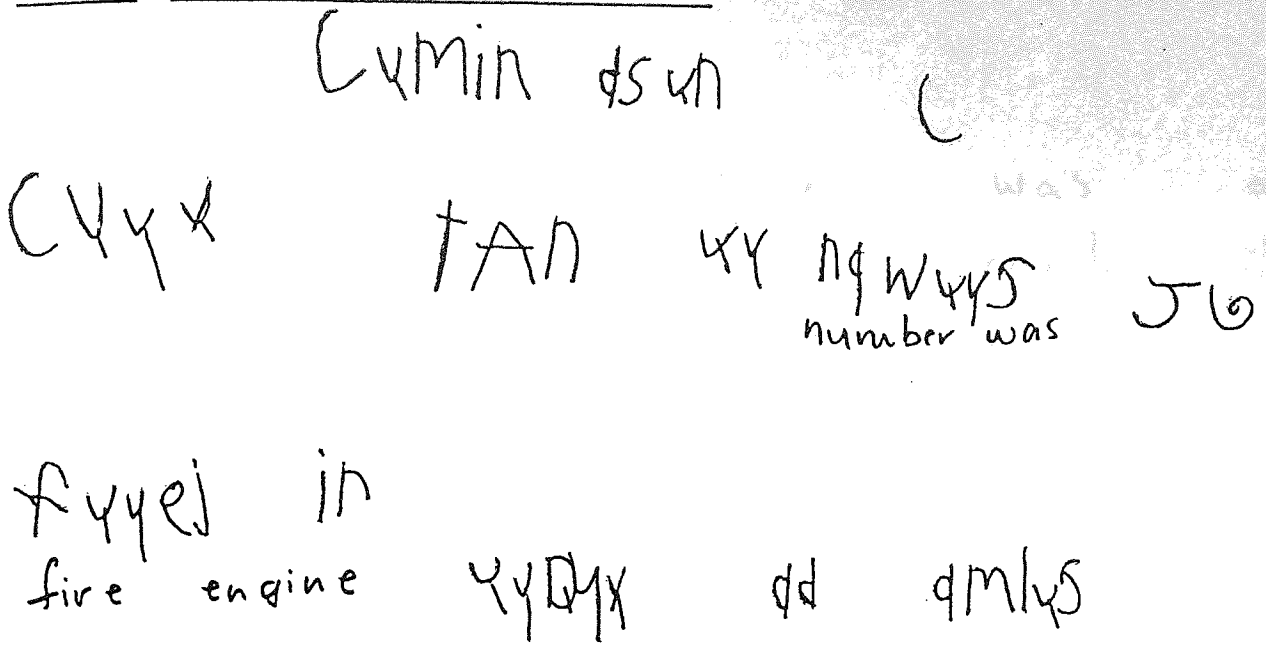
In the early 1960's the writer was working in a school psychological service. Among the children referred for treatment were many who presented not only behaviour disorders, but also gross under-achievement in written language skills - despite average or even superior general ability. Treatment at that time was based mainly on well sequenced remedial programmes presented within a framework of therapeutic and understanding acceptance of each individual child. Many psychologists, remedial teachers and therapists had been trained in the techniques of current educational psychology practice : viz along the lines described in Chapters 3 and 4 The thesis was in the main that, apart from the difficulties of the truly slow learning or of the severely neurologically disabled child, most other learning problems stemmed either from some 'emotional block' in the young child's developmental history, or from inhibiting socio-cultural factors. It was also recognised that these problems could be exacerbated by inadequate schooling. Causation of reading disability it was held, stemmed from the extrinsic environmental barriers as described in Chapter 4. (Newton and Thomson, 1974). Emphasis in teaching therefore was upon a facilitating therapeutic relationship, between child and teacher, opportunities for the creative expression of underlying anxieties and well-ordered sequences of work compatible with the learner's level of achievement. Within this understanding and child-centred mode of teaching some dramatic improvements in language skills were observed, particularly in the first few months. It was quite common, however, for a learning 'plateau' to follow the initial improvements. In many cases the children appeared very resistive to further learning. However, such early successes reinforced the current theory and practice and led to even stronger criticism of the medical diagnosis of a "word-blind" category of failure. The writer was working within this framework of therapeutic teaching and was committed to such treatment programmes as those described in Chapter 3. Her basic model of teaching was derived from the work of the Remedial Education Centre of the Institute of Education, University of Birmingham, where she had

pursued several years of post-graduate training and had in fact worked as Remedial Tutor.

Gradually it became apparent that however spectacular were the initial improvements in attainment and attitude in some cases there was still a marked difference in the style of learning and improvement between many of the children referred for 'retardation'. Some it seemed were able to perceive consistently the correct cues in the 'line drawings' and relate them to meaning. Teaching proceeded through techniques of reinforcement and extended relevant experience within a well-sequenced programme. Other children of the same ability range and from comparable socio-cultural backgrounds to the more successful children however seemed unable to derive perceptual and related meaning from written script - whatever therapeutic and planned teaching methods were used. A child of eleven from a supportive home and with ordinary school experiences would be referred as a complete non-reader, in spite of potential intellectual ability of a fourteen-year old. After a year or so of intensive teaching he would have perhaps attained a reading age of seven years, a spelling age of six years and the beginnings of very immature written expression. Table 7 presents examples of written work from such cases. They are typical of the written language performance of so many children referred for remedial education.

Indeed some children of eight, ten, or even fourteen years found written expression an impossible task. When encouraged, given techniques and continuous opportunity to write, the work was marked by characteristic errors. Amongst these errors the following patterns were repeatedly observed: confusion of order in letters, syllables, words and syntax; random or non-existent punctuation; random use of capital letters, both initially and within words; many types of spelling error including reversal (gril - girl), mirror image (saw - was), letter reversal (boll - doll; het - yet; but - put); unawareness of spelling patterns tending to bizarre

TABLE 7 EXAMPLES OF DYSLEXIC WRITTEN WORK



Boy aged 8 years.
I. Q 110
No birth trauma.

Our cat is calldareno
Its blue wer hade it For yers.
we came down spegby gurcun to the w

Boy aged 11 years
I. Q 115

TABLE 7

Onec apan a time there was a olb castel. In that casele ther was a Wiseb. He was non as the Wiseb of as on the tan siyb of the matinn. Tere was with but the wiseb was Jeles. So ther he sirteb looking up spells at last he fonb one That was secrit he fonb out thins he ranebib. on the other side of the matinn the with was making a spell at last She fonb that shell for when the wiseb calb hem to tea the wiseb parb & braps of

Boy aged 8 years
I.Q 130.
No birth trauma

TABLE 7

My Bickim

My Bicku is kolld a kung fin.-
I had a maer be my brother
Walter hute a bomfa and the maer
bomk. I hove a hoan as well were
I got it it wos brilyont boat
no its ofely.
Walter sads hed gat ma new one
this week.

Boy aged 12 years.
I.Q 118
No birth trauma.

I Lost my waye wen I
Kuming to Astun. DaDDy
had to ARSK Lost of gegul
Waye

people

Boy CA 8y 6m
Superior range intelligence
5-6/7

TABLE 7

presentations of irregular words (hothgu - through; hecs - cheese); incorrect phonetic representations (rede - ready; hows - house; cushn - cushion) and elaborations (runining - running).

The following is a typical piece of such writing from an intelligent and lively boy of eight years:

I hTh a Banin lon he is dafa
he gats my rould and he his z galss bous
From the seabed the bous rna fheul lifts and soufhit.

This is an attempt to express the sentence:

I have a brother-in-law. He is a diver. He gets me sea-urchins and he has three glass bottles from the seabed. The bottles are fossilised and starfish.

Such a child would possess the oral fluency and creative imagination of a twelve year old, yet his written essay would not be as competent as that of a slow-learning child of nine years. Older children could be scientifically aware and able thinkers yet unable to write laboratory reports and descriptive essays about their science interests.

Reading itself, when some achievement was finally reached, would be slow, lacking in fluency and marked by regressive eye-movements along the line of text. There would be difficulties in patterning phrase and sentence structure; an apparent hiatus of order and sequence. Mis-readings would often occur and there would be the need for constant checking in order to derive the necessary information and understanding from the text. Often a child (or young adult referred for reading difficulty) would have developed a technique of reading a line of print twice - once for word recognition and the second time for meaning. Oral reading would be slow and deliberate, marked by interruptions and confusions and "losing the place". Often commas and full-stops would be ignored, voice stresses would not match the underlying structure and there could be a tendency to reverse direction in the middle of a line. During all this "mechanical" confusion, context and semantic

content would be lost and the child would need to read the material again to achieve the necessary symbolia for meaning.

The "barriers to learning" often caused secondary emotional problems for many of those affected. Some typical reactive patterns of behaviour were: withdrawal from academic and even social activities; avoidance of other learning tasks in which success would have been possible; regression to immature patterns of behaviour such as temper-tantrums, nail-biting, enuresis and an over-dependence on adults; attention-seeking behaviour; aggression against other children and destruction of property; general insecurity; a tendency to cry easily and an all-pervading misery. These problems were often exacerbated by an under-evaluation of a child's true competence. The children were frequently regarded as "lesser individuals" by teachers who would relate reading failure to general underlying ability. The writer has often been told by a head-teacher "How can you tell me that this child is intelligent when he cannot read!" Boys from less supportive home backgrounds would seek compensation in socially (or legally) unacceptable behaviour and eventually find their way to clinic help through the Courts.

Other epi-phenomena were noted. For example the high incidence of spatial, mechanical and scientific abilities amongst the population of retardates. Many boys at the secondary stage of education were skilled in technical and engineering drawing. They could easily assemble engines and machines - indeed one fourteen year old boy with a reading age of six years made a steady income from assembling bicycles from scrap-yard pieces. Many had scientific interests. Reading was motivated in the case of four failing adolescents by the successful construction of a crystal-radio - an exercise which necessitated the buying and reading of manuals and plans and the writing of constant progress reports. Others were knowledgeable about animals and expressed career wishes to be veterinary surgeons or to work with the PDSA - occupations quite within the scope of their general underlying intelligence and problem solving ability; yet they despaired of ever satisfying examiners in the necessary assessment tests to qualify for tertiary education. Other specific abilities were in art, sculpture, pottery and design; in athletics; and in musical ability. Special abilities were also observed in

geography, biology, zoology, chemistry and spatial mathematics.

These specific aptitudes were not only prevalent amongst the children referred for reading difficulties, but were constant features of many members of the children's families.

It became increasingly evident to the writer that some variable (or set of variables) intrinsic to the child himself was exercising a powerful influence which mitigated against the perception and acquisition of written language skills. Accordingly, a list of "soft neurological signs" was drawn up and incorporated into a questionnaire. In 1965 this questionnaire was sent to several Birmingham Primary Schools. Teachers were asked to list the children who appeared to possess any of the following symptoms:

Characteristic:

1. Clumsiness, e.g. difficulty in kicking, skipping, throwing, catching, climbing etc.
2. Defective speech
3. Lack of concentration
4. Low tolerance of frustration at own achievements
5. Difficulty with directional attack i.e. reverses or confuses order of letters, words, phrases in reading and writing
6. Seems 'odd' - different from other children
7. Poor retention in learning to read new words
8. Tendency to fall easily; accident proneness
9. Left handedness in writing or with tools
10. Signs of ambidexterity
11. Mirror writing
12. Restlessness; hyper-activity
13. Discrepancy between apparent 'brightness' and school progress.

Children presenting three or more of these characteristics were assessed for intelligence level and reading ability.

The following points emerged:

All the children came within the normal or normal-plus range of intelligence and were seriously retarded in reading, spelling and writing. The positive responses represented about ten per cent of the school's population. In many cases, unresolved dominance together with faulty directional attack on letters and words were key features. In others, hyperkinesis and inability to sustain concentration were dominant.

The questionnaire had picked out all the children with chronic reading difficulties. The teachers, in the main, were unaware of the implications of neurological involvement; this meant that unsuitable methods of teaching had been practiced, in many cases adding emotional factors to the primary difficulty. The results from this small pilot enquiry supported both the clinical observations over years and also the theoretical studies of the neurologists who were involved in this field of learning.

To the writer the problem was that of finding a method to investigate this primary difficulty, which appeared to stem from neurologically based individual patterns of development. In 1965 the tide of opinion on reading disability was overwhelmingly in favour of the educational psychology concepts listed in Chapter 4. It was almost impossible for the views of a teacher or clinical therapist to be accepted seriously if they came outside this framework. Very few remedial teachers or educational psychologists had the training and experience in neurology to enable them to support a theory that there could be other, intrinsic factors operating to prevent the easy acquisition of written language forms. How could a non-medical person, who was deeply involved in the learning patterns of children, measure in some experimental, scientific way the brain activity of a child and its relationship with the factors involved in reading and spelling?

It was at this time that the writer became aware of the Neuro-psychology Unit of the University of Aston in Birmingham. The Unit was developing a sophisticated technique of electro-encephalography as a method of investigating brain activity. From small measuring devices, i.e. silver stick-on devices applied to the intact skull, recordings could be made of the spontaneous electrical patterns transmitted from the subject's brain. (see Appendix 1)

It appeared feasible to the writer that this method could be used in an experimental design to compare the patterns of children who were experiencing severe reading difficulties with those of children who were reading quite ordinarily.

A possible key to the phenomenon appeared to lie in the difficulties, which were experienced by those involved, in acquiring series; in remembering order; in appreciating direction - all important features of the skill to be acquired. Thinking was directed to the work of Orton (op cit) and his observations on inconsistent laterality and on the 'lack of cerebral dominance' in his patients. His writings seemed supported by many clinicians in America and Scandinavia and also by the writer. Neurological findings on the functional aspects of the two brain hemsipheres, some of which were described in Chapter One and Chapter Four, also lent support to a possible aetiology of confusion, when two-brained man was faced with a one-brained task. Reading and spelling could be two such tasks i.e. uni-directional, perceptual and motor activities to be organised by a possible two-directional (or even multi-directional) brain.

The experimental task therefore would be to measure and compare electric activity from the brain hemispheres of two groups of children- one group of successful readers and the other group of unsuccessful readers, and then to make inter- and intra-group comparisons. This work was subsequently carried out in 1966 under the supervision of Dr Harding. (Newton, 1968)

In summary the electro-encephalographs of twenty-five children with severe reading disability (dyslexia), and who had received at least fifteen months remedial teaching therapy were compared with a similar number of matched controls whose reading ability was within the normal range. The groups were matched for intelligence range (80 - 125 as measured by WISC), socio-economic status, school opportunities and age range (8 to 13 years).

The eye/hand dominance of the children in both groups was recorded. Pre-, peri- and post-natal histories of the experimental group were recorded, together with information on familial laterality. The statistical analysis of the data showed a significant difference between the 'cases' and 'control' groups in the symmetry of alpha activity, the 'cases' having almost exact symmetry of alpha rhythm i.e. between left and right cortical hemispheres. Such findings indicate a less facilitating condition for the acquisition of language and reading skill.

Parts of the EEG for each child were submitted to automatic analysis on tape. In the cases of reading failure, there appears to be a smaller lateral predominance. Temporally there appears firstly a smaller asymmetry of alpha and theta indicating no defined cortical dominance, and secondly a lateral equivalent in concordance i.e. cortical organisation. In the control group, however, cortical organisation shows greater lateral differences in the occipital regions, but either right or left may predominate. In the temporal regions there is an asymmetry of the alpha rhythm, indicating cerebral dominance, with, in addition, an asymmetry of theta abundance. There was greater concordance in the right hemisphere.

Since that first experiment, clinical and research work has been continued throughout the ensuing nine years. Clinical data has been collected from children and adults referred for possible dyslexic difficulties who attend the weekly diagnostic and advisory clinic. Some variant of the same clinical syndrome has been observed in each of the four hundred persons who have attended during this time i.e. inconsistent laterality patterns, a family history of other members with similar patterns together with poor performance in reading, spelling and writing; special skills in perceptuo-spatial tasks such as engineering, design and architecture; success in laboratory-oriented subjects such as pharmacy, biology and chemistry; specific ability in spatial mathematics (e.g. geometry, 'set' mathematics) and special interests in photography, domestic arts, woodcraft, metalcraft, geology and sport. Performance tests have revealed difficulties in visual sequential memory, auditory sequential memory, short-term memory for digit span, serialisation of common sequences, knowledge of left and right directions, fine motor fluency and sound-blending. Each person presents an individualistic combination of such difficulties, a distinctive profile peculiar to himself; yet based on a seemingly typical pattern of confusion in symbolic order, direction and sequence.

5.2 EXPERIMENTAL STUDIES

During the last four years, apparent key areas from the mass of clinical data have been examined in the laboratory. Special studies have been made of individual differences in laterality; familial incidence of

laterality patterns; individual skills related to differing patterns of laterality; visual and auditory sequencing abilities related to reading; the ability to retain arbitrary strings of symbols and its relation to laterality and an analysis in depth of sixty-four of the cases who were referred to the department for specific reading and spelling difficulties.

Summaries of these studies are as follows:

Newton (1970) - a sample of adult subjects drawn from disciplines of engineering, art/design and linguists were compared on tests of visuo/spatial ability (Minnesota formboard), verbal ability (General Ability test), laterality and graphomotor fluency. EEG recordings were taken from all these subjects of the activity in both hemispheres of the brain. Comparisons were made between the different groups and both inter and intra the hemispheric EEG activity. Examination of the data suggests that linguists show right dominant trends in laterality, with better verbal as opposed to visuo/spatial ability, whereas the engineers and artists both show inconsistent patterns of laterality, superior visuo-spatial ability but less verbal ability. Visual inspection of the EEG recordings suggest a difference in activity between the brain hemispheres especially in the temporo-parietal areas, whereas the engineers and artists show more equivalent patterns of electrical activity between the hemispheres in these areas. EEG recordings showing these differences can be found at the end of Appendix 1.

Newton and Bates (1973) - 13-item handedness questionnaires were distributed to approximately 2,000 engineering, art and foreign language students, on full-time courses at the University of Aston, Birmingham Polytechnic and the University of Birmingham. 678 questionnaires were returned. Individuals were classified as consistently handed if they reported at least 12 of the 13 items with one hand. It was found that art students (n = 184) contained the smallest proportion of consistently handed individuals (43 per cent) while modern language students (n = 226) contained the largest proportion (69 per cent). 54 per cent of engineers were consistently handed. These proportions were significantly different (x^2 = $p < 0.001$). Other results were

obtained to strengthen the hypothesis that the individual with (presumed) good visuo-spatial, artistic ability will possess a greater degree of ambidexterity than the individual with (presumed) good linguistic ability.

Newton and Thomson (1973) - the performance on selected test items of twelve children with spelling and reading retardation of at least $1\frac{1}{2}$ years was compared with a control group with average reading and spelling ability. (age range $7\frac{1}{2}$ years - $10\frac{1}{2}$ years; intelligence range from 85 - 125).
The test battery consisted of the Raven's Progressive Matrices A, AB and B and the English Picture Vocabulary Test; the visual sequential memory, auditory sequential memory and sound blending subtests of the Illinois Test of Psycholinguistic Abilities; a 'laterality' questionnaire on handedness, eyedness and footedness; a 'reversals' test involving the reproduction from memory of a sequence of pictures (e.g. fish, mouse, face, etc.) which could be placed in two directions, only one being the correct response.
The experimental group (reading retardates) scored significantly lower on the visual sequential memory (t test $p < 0.001$) and the auditory sequential memory (t test $p < 0.02$) subtests of the I.T.P.A. A similar trend was observed in the sound blending, although it was not statistically significant. The experimental group were significantly less well lateralised showing a more inconsistent pattern of handedness/eyedness/footedness (Mann Whitney U test $p < 0.025$) and significantly more errors on the reversals test (Mann Whitney U test $p < 0.01$). The experimental group also scored significantly better on the Raven's Matrices than on the English Picture Vocabulary Test when compared to the control group (t test $p < 0.025$).

Newton and Restorick (1973) - three groups (consistent right lateralised subjects, consistent left lateralised subjects and a group with inconsistent laterality) were selected on the basis of a laterality questionnaire. The subjects were all male sixth formers. The main test involved the presentation of strings of letters of different lengths, the subjects being required to write down what they remembered

after each presentation.
The inconsistently lateralised subjects produced significantly more incorrect sequences and incorrect letters, with noticeably more errors of displacement and letter reversals. Furthermore, these subjects also made more errors in a spelling test, and showed a greater incidence of inconsistent laterality and verbal difficulties in the family.

ANALYSIS OF CLINICAL DATA - the test results of sixty-eight clinic cases referred to the department for specific reading and spelling difficulties were analysed. This group was matched with a control group for intelligence range, age (8 - 15 years) and socio-economic level. The referrals were retarded in reading by an average of two and a half years and in spelling by three and a half years. The sample included fifty-four boys and fourteen girls.

Intelligence: the referral group was skewed positively on the Raven's Matrices (8 superior, 2 above average, 25 average, 6 below average and 1 defective in intelligence).
On the Stanford-Binet vocabulary scale, 21 scored two or more years above their chronological age, 21 one year above, 27 the same as their chronological age, 4 one year below, and 0 two or more years below. There was no significant difference between the referrals, and the control group who showed a similar distribution on the vocabulary.

Free writing: the free writing of the children was judged on the following criterion - reversals, 'bizarre' spelling, motor control, fluency of idea, syntax, punctuation, correct use of capitals, use of clauses, developed vocabulary and overall competence. The referral group was significantly poorer than the control group (Mann Whitney U test $p \leq 0.02$).

Laterality: laterality was measured by questionnaire on hand, eye, foot and ear dominance for various tasks, and inconsistent laterality denoted by a deviation from all sensory and motor functions being all right (or left) lateralised. The referral group were significantly less well lateralised than the control group (Mann Whitney U test $p < 0.025$).

Family history: the familial background of reading and spelling difficulties, inconsistent laterality patterns and 'at risk' birth histories were noted. Points were taken from a maximum score for the presence of these in the family. The referral group scored significantly less on this measure than the control group (Mann Whitney U test $p < 0.05$).

5.3 DISCUSSION

The studies reported above, together with the ever-increasing evidence from clinical case histories, are supportive of the findings and hypotheses which have been discussed throughout this thesis and indeed which are the central issues in this investigation of primary written-language difficulty, viz. the view that lateral dominance and a particular pattern of cortical organisation are underlying determinants for man's acquisition of serial, ordered symbolic skills. At another level this organisation may be reflected in the lateralisation of sensory and motor mechanisms. Furthermore, individual differences in subskills, particularly of a sequential nature are affected, which may in turn affect the acquisition of reading and spelling.

As a result of these findings a model of written language learning can be developed. This relates initially to the nature of written language itself. In examining the written language the constraints of the system become apparent. In must be remembered (ref. Chapter Two) that written English is based on a written alphabet of twenty-six letters or graphemes - a set of 'line drawings' arbitrarily determined to represent the 'phonemes' or sounds of speech. (Gibson, 1965). It is characterised by rules, regularities, order, direction and sequence. It must therefore be learned. In order to learn the rules and techniques and relate them to required meaning, every letter syllable, word, phrase, sentence must be perceived in exact form. "het god saw no leg ded", although containing the required letters and word lengths, does not convey the meaning "the dog was on the bed". The line drawings are often the mirror-image of each other: b,d; p,q; w,m; n,u. If the word 'doll' is scanned by a left-eyed child, the

message received by the brain could be 'llob', which bears no relation to the teacher's reinforcing sound pattern 'doll'. Many words have mirror-image forms: was, saw; on, no; or possible internal rearrangement: bird, brid; girl, gril. There is a left/right direction across the page, both to read and to write, and an ordered line progression down the page. The brain can only organise the message transmitted to it by the receptors. If consistently ordered patterns, exact representations of reality, are not transmitted, no exact engrams (or memory traces) are stored and cannot therefore be retained and retrieved in meaningful form. The consequent muddle to the young learner is characterised by reversals, mirror images, bizarre spelling, slow, regressive reading patterns, inability to acquire written fluency, to use punctuation, to acquire the rules of syntax or even the total inability to learn to read. The multiplicity of observed difficulties which ensues from initial uncorrected muddle can probably lead to the statement by Clark (1972)

"The striking finding was the diversity of disabilities, and not an underlying pattern common to the group".

The 'diversity' represents the individual child's developmental pattern interacting with random teaching techniques together with his own phonetic and graphic attempts to reproduce the material.

I hTh a Banin lon he is dafa
he gats my rould and he his z galss bous
From the seabed the bous rna fheul lifts and soufhit

This is an attempt by a very intelligent eight year old boy, without adequate teaching help in rules and regularities to express the sentence:

I have a brother-in-law. He is a diver. He gets me sea-urchins and he has three glass bottles from the seabed. The bottles are fossilised and starfish.

In order to work this system stable memory engrams of symbols, sequences and directions are required, so that they must be perceived consistently (auditorily and visually), stored consistently, retrieved and reproduced consistently (phonetically and graphically). In consequence, inconsistencies in perceptual and motor ordering prevent the acquisition of the fundamentals needed for reading,

writing and spelling. One stresses again the young developmental age at which this system must be acquired.

The experimental studies described could have direct implications for the actual performance of the so-called dyslexic child; the key features being the visual, auditory and kinesthetic direction and order inherent in the written language system. The incidence of inconsistencies in order and sequence amongst the samples of dyslexic children highlight the nature of their perceptual and motor difficulties. Furthermore, the neuropsychological (EEG) studies suggest an underlying neurological basis related to symmetrical or asymmetrical hemispheric function, apparently giving rise to individual differences in "acquiring series". On a broader level this difference in brain organisation could be related to individual styles of thinking or problem solving, that is representing the world symbolically or spatially.

If this relationship between hemispheric function in the brain and acquisition of certain skills represents an actual phenomenon in man, there are serious implications for the educational systems. Prime importance must be attached to the awareness of such intrinsic developmental patterns in order that appropriate schemes of teaching can be devised. Once this primary condition is recognised, it can be viewed quite ordinarily as one of the influences affecting the individual child's learning and one that interacts with environmental, emotional and intellectual factors, resulting in the child's learning performance.

Increasing emphasis is being placed on the early detection and screening of such learning disabilities - both for effective remediation and preventative teaching (Goldberg and Schiffman, 1972; Naidoo, 1972; Eisenberg, 1962). This is reflected in the increasing number of screening tests which are being researched into, particularly in the United States of America. Shephard (1974) reported seeing one hundred and thirty-five such tests on her recent tour of Educational Research Institutions in the United States.

By 1970, the writer herself was involved in planning an integrated approach to the problem of early identification of this specific type of learning disability. The factors under consideration were those described already in this thesis: an awareness of the historical factors including those related to the teaching of reading, during the last hundred years; more recent approaches to the whole concept of language and linguistics; the barriers to school-learning as seen by the psychologist, sociologist, educationist and neurologist; and the evidence of a dyslexic-type of language problem as it has emerged in neurological studies since 1873.

A global approach to the problem, taking into account all these aspects of study, was thought to be the most effective way of beginning the task of early diagnosis. The next chapter describes the course of such a beginning.

CHAPTER SIX

PREPARING AN INSTRUMENT OF DIAGNOSIS

6.1 FIRST CONSIDERATIONS

The first stage of diagnosis began by accepting the proposition that a specific category of learning difficulty exists in the population; and that it is manifested only when certain individuals are faced with the formal task of acquiring a graphic script-form to represent spoken language, especially at the early developmental age of 5 years. The second stage was to define the symtomology of this category i.e. to recognise the patterns of presenting symptoms in the individuals affected. Once having established a recognisable syndrome it should then be possible to prepare a list of relevant features, an Index of items which appear to categorise the phenomenon. This then was the task: to devise an Index which would yield a characteristic profile of scores, to be used for both predictive and diagnostic screening for early difficulties with the written text.

6.2 CLASS-ROOM USAGE: IMPLICATIONS AND APPLICATIONS

A most important feature of such an Index would be its direct availability to TEACHERS. In chapter three the writer described an 'ideal' model for first school beginnings: a small group of children, an appropriate environment and a well-prepared teacher who would observe and understand the individual differences in learning potential. The Index would be designed to provide a focal point for day by day observation and thus focus attention on the critical features of possible vulnerability; vulnerability, that is, to failure in acquiring the rules of a written-language system. The 'critical features' of the phenomenon as described in this thesis are seen by the writer to involve the following areas:

a) cerebral dominance in the central nervous system
b) laterality of motor and sensory mechanisms
c) disabilities in sequencing symbolic material; in recognising order and directionality
d) genetic aspects in families
e) the phenomenon of accompanying spatial ability in family background
f) the role played by 'at-risk' involvements at birth.

All these features must be represented therefore in the Index.

Account must also be taken of previous studies on 'barriers to learning', viz. the effects of socio-cultural factors, possible underlying emotional tensions and the level of general underlying ability.

Because the aim would be to give the teacher at the 'coal face', i.e. in the classroom, the power to predict and diagnose, certain criteria must be observed. These are: a basic and simple content to the items which would not demand long specialist training; tests which are easily available to teachers i.e. 'open tests'; tests of short time span which can be realistically administered in the busy working day of a teacher; a series of items which can be taken on consecutive occasions and which need not be given all together at any one time; tests which are easily scorable and whose results can be seen at a glance when presented in a 'profile'; no elaborate and expensive material which could deter provision by some schools; easily replaceable material; and a convenient pack for storage and easy handling. Into this type of format then it was hoped to include a comprehensive list of items which would represent the features of the dyslexic type category of difficulty.

Recapitulating the vital areas under observation and especially bearing in mind the list of symptoms on page the Index would need to investigate the following areas:

General underlying ability
Laterality organisation of the individual
Family patterns of laterality
Family patterns of skill
Birth history
Socio-cultural factors
Visual sequential memory
Auditory sequential memory
Common series acquisition
Sound blending
Sound discrimination
Performance items of the written skills under investigation.

Screening could take place at two levels. First as a predictive

exercise and secondly as a diagnostic assessment. Consequently two forms of the Index were envisaged. The first form was intended for use by the reception class teacher, when the child had been in school for about six months and when the teacher had noticed difficulties in expected attainment, discrepant with apparent "intelligence" and social competence. The second form was to be administered at 7+ years for puzzling cases of non-attainment. This might include the 'slow-learning' child who can equally be affected by dyslexic-type confusions in serial symbolic material as well as for children whose verbal style and problem solving ability appear to represent normally developing intellectual abilities.

By using these two forms of the Index, a teacher could discover the more severe difficulties which would need the referral of a child to consultant specialists e.g. for a more exhaustive test of intelligence, needing the services of an educational psychologist; audiological or ophthalmic examinations; neurological or endocrinal investigations. It would be seen by the teacher therefore that a third form of the Index would exist for this specialist level

6.3 RATIONALE OF INDEX ITEMS

The Index is intended as an early-warning system for the class-teacher. The items must therefore be selected to cover all the possible areas in which school children could be at risk in the first stages of formal language learning. The thesis has described in Chapter Four the key problem areas as 'barriers to learning', viz. intellectual, physiological, neurological, emotional and socio-economic barriers. Basic items must be selected therefore to represent these well-documented aspects of possible failure to learn.

Such events are considered by the writer, however, to be of secondary, or coincidental, causation in many cases of reading failure. The thesis is concerned to define and describe a primary barrier - an intrinsic, developmental feature of neurological origin. It is marked by individual maturational patterns of confusion in perception (visual and auditory), problems of directional motor fluency and ill-lateralised underlying language mechanisms. Such patterns of

development are held by the writer to be incompatible with the nature of the skill to be acquired. They do not match the arbitrary uni-directional, ordered and sequential aspects of written alphabetic graphic script. Overt behavioural signs of such intrinsic probabilities seem to lie in the following areas: marked incidence of inconsistent and unresolved laterality patterns (i.e. of hand, eye, ear, foot) in both the affected individual and his family generally; visual, auditory and motor sequencing difficulties in the performance of written language skills (i.e. the inability to acquire competence and fluency in reading, writing and spelling; inability to 'acquire series' and the ordered language strings of common practice (i.e. to recite the months of the year); confusions over the knowledge of left and right directions; reversals of letters, morphemes, words and word strings; slow and laboured approach in reading and writing; difficulties of placing script upon page; omissions of letters, words and punctuation; random use of upper case letters; failure to grasp syntactical form, gross discrepancies between oral ability and quality of ideas on the one hand and the ability to represent them in written language form on the other. In many cases discrepancies between innate intellectual potential and level of school achievement, difficulties in short-term memory for digits especially reverse strings. The Index must contain items, therefore, which assess levels of performance in these areas.

Teaching and clinical experience suggests the need for two forms of the instrument: one to be used as a predictor, i.e. for use in the earliest stages of school learning. Referring again to the writer's model of the reception class-room, it would seem feasible to provide the teacher with some concrete means of assessing the probable 'at-risk' child in the initial stages of education. Remembering the difficulties of the first days at school as described in Chapter Four it would seem advisable to allow time - say six to eight months- for the child to settle and become accustomed to the new social and cognitive experience of school. If at the end of such a period signs of difficulty become evident - e.g. the beginnings of avoidance of writing materials or such features of the reception room as book-corners, the writing of daily 'news', recognising labels, sharing a reading book with teacher or a reading-group, writing names etc; or noticeable discrepancies between a child and the peer group with whom he started school - the perceptive teacher would be helped by some concrete measure which would focus attention on the key areas of underlying difficulty. If features

associated with the category of dyslexic-type syndrome were thus identified, teaching could proceed with awareness, insight and the relevant structuring of teaching material. Failure, rejection, annxiety, punishment, guilt, loss of self-esteem and all the consequent psychological (and concomitant physical) ills could thus be avoided and the foundations of future education be laid in a positive, facilitating climate. The instrument for prediction then would be the first stage in awareness. A second stage of critical importance has also been identified. This is the seven-plus year stage when many children transfer from infant to 'junior' departments. It is often assumed that at this time techniques of reading, spelling and writing have been acquired and the formal use of these techniques is set in train. The dyslexic child, however, unless recognised and helped at this stage also, will be unable to meet such formal requirements at the speed and depth demanded by the system. Slow-learning dyslexic children also need special recognition at this stage as do the emotionally-blocked or 'at-risk' born dyslexic children. This is the stage of diagnosis proper, following upon the earlier predictive stage. The child has now been involved in school learning for two and a half years at least. Measures can be taken, therefore, of whatever competence levels in reading, spelling and writing have been attained as well as the instrinsic, developmental factors mentioned previously. The dyslexic-type category of written language difficulty can be recognised by a 'profile' approach - by a consideration of all relevant features of the syndrome. Supplemented by appropriate tests of underlying general ability, this second stage of diagnosis can be adapted for use in the total span of school age-range and indeed for diagnosis of adult dyslexics where required.

With all these criteria in mind, the writer devised the format shown in Table 8 for the experimental version of the Index.

TABLE 8

FORM I	FORM II
General Underlying Ability	**General Underlying Ability**
1 Picture Recognition	1 Goodenough
2 Vocabulary	2 Vocabulary items
3 Goodenough	3 Copying geometrical designs
4 Copying geometrical designs	
Family History	**Family History**
1 Laterality	1 Laterality
2 Birth History	2 Birth History
3 Knowledge of left and right	3 Knowledge of left and right
4 Socio-cultural setting	4 Socio-cultural setting
Performance Items	**Performance Items**
1 Write or copy name 3 times	1 Reading (Schonell)
2 Visual sequential memory pictorial	2 Spelling (Schonell)
3 Visual sequential memory symbolic	3 Free writing
4 Digits - forward and reverse	4 Graphomotor test
5 Sound discrimination	5 Visual sequential memory pictorial
	6 Visual sequential memory symbolic
	7 Auditory sequential memory
	8 Sound blending
	9 Sound discrimination
	10 Knowledge of left and right
	11 Sound/symbol correspondence
	12 Reciting common verbal sequences

Standardised instructions for each item of the Index were written in accordance with established psycho-metric practice (Vernon, 1962) and in accordance with developmental apprehension span for spoken language (Piaget and Inhelder, 1973).(Brown, 1965, 1973).

One item needs further discussion:
A vocabulary scale for specific use in the Index is currently being standardised alongside the Terman-Merrill vocabulary sub-test. It is designated the Aston Vocabulary Scale. Items for this scale were selected by randomising the total word usage of ten first reading schemes plus randomised items from the Burroughs (1957) Vocabulary Scale and the Thorndike-Lorge (1944) scale. Further reference to this scale is made on page

Other subtests of the Index e.g. Geometric design, Schonell reading and spelling, Raven's Matrices and the E.V.P.T. have already been standardised.

6.4 CRITERIA FOR SELECTING THE ITEMS

The area of 'general underlying ability' is included to measure the child's 'readiness' - not in a strict sense, but in order to establish that basic factors are favourable for the acquisition of the reading task.

The picture recognition sub-test looks at the child's ability to give verbal labels to the world around him; obviously before reading and writing can be attempted the ability to conceptualise objects is of paramount importance - (early verbalisations consist mainly of nouns). Related to this is the vocabulary scale which looks at the ability to extract meaning from words and identifies the receptive understanding of the child. Reading and

writing cannot progress in a satisfactory manner if the child derives no meaning from the words he is using. (Many children, however, although understanding verbal concepts and semantics, are still unable to acquire the automatic, sequential and arbitrary skills involved in written language. The Index assesses such potential in the performance section).

The Goodenough 'Draw-a-man' test is included to obtain some idea of the child's general ability. The results yielded from this apparently simple drawing test have been found to correlate highly with scores obtained from other individual measures of intelligence. It is necessary to establish such "readiness" level, as a child with slow learning potential (i.e. of low mental age) may be at risk anyway in his ability to acquire the conceptual framework, as well as possible difficulties in perceptual skills.

Copying geometrical designs requires the child to draw the shapes of a circle, square, triangle and diamond. Performance on this task gives a measure of the perceptuo-motor development of the child. At 5 or 6 years old, most children should be able to reproduce a circle and a square, and at M.A. 7 years are able to copy adequately a triangle and a diamond. As well as the clinical and observational experience of the writer and many other educationists on these indices of developmental stages, these items have their origin in well standardised and accepted tests such as the E.P.V.T., Stanford-Binet Intelligence Scale, and Goodenough Test; thus providing the rationale behind the 'general underlying ability' concept.

The second area explores the family background and child's laterality. The type of specific reading difficulty under investigation is often a familial one, as well as being associated with underlying patterns of laterality and cerebral dominance. The child's laterality is therefore explored by a number of items investigating handedness, 'footedness', eyedness, etc. A pattern of inconsistent laterality (e.g. left eye/right hand) or uncertain and confused handedness could be indicative of difficulties in ordering and sequencing the unidirectional task of reading. The pattern of family laterality is also noted because an indication of uncertain dominance and confused laterality often revealed in these cases, together with a history of

poor spelling or reading, gives an insight into the familial and genetic nature of the disability. (Critchley (1964), Orton (1937), Newton (1971), Naidoo (1972), Zangwill (1971).

If possible, the birth history is also noted, as frequently an 'at risk' birth may give rise to later difficulties in symbolic types of learning at school (Kawi and Pasamanick, 1959.)

It is also well established that psychogenic factors may block the acquisition of symbolic learning; a question is included to cover these more socio-cultural influences.

The performance items forming the third part of Form I are those which have been found to correlate with this type of reading difficulty. The visual sequential sub-tests and the auditory sequential (digits forward and reverse) sub-tests are included. These give an indication of the ability the child has to order sounds or symbols in an arbitrary sequence, which is of paramount importance in this directional task. The nature of the task to be learnt (reading, spelling, writing) requires the perception, retention, and the reproduction of sounds and symbols in an order and sequence (Naidoo, 1972; Thomson, 1971; Goldberg, 1972) The visual sequential memory consists of symbols and pictures in sequence which the child has to put in the correct order after having a sequence shown to him by the tester. The digit span consists of the child repeating a series of digits in the same order, and in the second test, in the reverse order. Poor performance in these sequencing types of task would again be indicative of a specific directional and sequencing difficulty.

A sound blending sub-test is included to measure the ability to make a meaningful word from its constituent sounds (e.g. c-a-t makes ? - again often a particular difficulty) and also to give the teacher some idea of the efficacy of a phonic approach to reading. Relative superiority in either the visual or auditory subtest would of course have important remedial implications, e.g. a stress on the better skill to acquire some reading with "overlearning" teaching to improve the weaker. Finally, a sound discrimination test is included to test

simply the ability of the child to repeat words that are spoken to him as a crude auditory acuity measure. Special attention is directed to initial and final sounds, Both these tests relate to the ability to distinguish phonemes, and to blend these together to make symbolic sense. (Bannatyne, 1971; Shankweiler and Liberman, 1972).

Form II consists of the same items as for Form 1 on the performance Section, except that the Picture Recognition has been dropped from the general ability section and it is suggested that other general ability measures such as E.P.V.T. and Ravens Matrices are used. Because Form II is more of a diagnostic instrument rather than an 'early warning system', some further items have been included in the performance section:

In order to measure the dependent variable the Schonell reading and spelling tests are included. Reading and spelling age are based upon graded words becoming progressively more difficult. The level of reading and spelling should of course be related to the child's ability as well as chronological age, to get a real measure of under or over-achievement.

A sample of free writing is included, and this can be an important diagnostic factor. The number of reversals, bizarre spellings, pure phonetic spellings, general motor control, fluency of idea and expression, syntax, punctuation, etc. may all result in an overall picture of the child's abilities, and particular attention should be directed to a discrepancy between the child's written performance, and his language and intelligence levels as manifested orally. (Criteria for Free Writing items - Rabinovitch (1954) Critchley (1970) Miles (1970) Newton (1974).

The final performance item is the grapho-motor test in which the child copies a pattern with right and left hands, with both hands at once, and in different directions. This gives a general idea of fluency and motor control as well as relating to the laterality items - is the child fluent with both hands, can he cope with two directions at once easily, etc?

Difficulties in directional motor fluency are highlighted. This test is derived from work on directional confusion in skilled tasks (Gerhardt, 1959) The author now uses the test in the selection of pilots for the Norwegian Air Force after standardisation both on service personnel in Norway and America and on dyslexic subjects. It was devised in accordance with Gerhardt's 'direction' hypothesis, described in Chapter 4. Form II then should give a wide view of the child's abilities and skills, in relation to the reading and writing task.

6.5 COMPILATION OF TEST ITEMS

Sub-tests representing the items described in the previous sections were prepared, together with stimulus cards and carefully planned instructions for administering the items. A scoring sheet was also prepared, together with a completed example. Profiles were drawn from the latter and interpretation described. A pack was designed which appeared to meet the criteria described earlier of feasibility for handling in the classroom situation. A video-tape was prepared of the actual administration of the Index for instructional purposes. The next stage was the experimental use of this first draft in actual clinical and class-room situations and the validation of the items. The next section, therefore, describes this work. It was decided to include a Form III in the Index. This would be for use by the Psychologist and would comprise 'closed' tests such as the Wechsler Intelligence Scale for Children, The Wechsler Adult Intelligence Scale, the Illinois Test of Psycho-linguistic Abilities, the Wepman scales, the Marianne Frostig Perceptual Tests etc. Reference would also be made to audiology and ophthalmological tests and other neurological examinations. As well as ensuring the availability of such specialist expertise for the individual child, the inclusion of Form III in the Index would alert the teacher to the possibility that a deeper investigation might be necessary. He (or she) would have the power to do the first screening, but where severe problems seemed to emerge from this, referral to specialist agencies is highlighted.

6.6 THE FIRST STAGES IN VALIDATION

Examples of scoring, profile and interpretation are on the following pages. A complete copy of this first experimental version of the Aston Index is to be found in the Archives, Applied Psychology Department, University of Aston.

6.6.1 Concurrent validity

The first validation exercise was concerned with Form II of the Index. As described in the previous sections, this form consists of the following items: The Goodenough Harris Draw-a-Man test; the Stanford-

SCORING THE ASTON INDEX

The following guidelines are given as a pilot scoring system for the Index. From the scores a diagnostic profile of a child's ability and attainments can be plotted. In this way both the weak and the strong areas of his profile can be seen at a glance.

FORM I

GENERAL UNDERLYING ABILITY

Item	Criteria	Maximum score	Minimum score
Picture recognition	Number of items correctly identified	8	0
Vocabulary test	Mental age levels as indicated in test scoring. If M.A. is 1 year or more over chronnological (C.A.), score +2; if M.A. is 1 year or more less than C.A., score -2. Score 0 if less than 1 year either way.	2	-2
Goodenough Draw-a-man test	Standardised scoring gives M.A. as discussed in test. If M.A. is 1 year or more over C.A., score +2; if M.A. is 1 year of more less than C.A., score -2. Score 0 if less than 1 year either way.	2	-2
Copying designs	(1) General impression of the figure as a whole, not just "lines", i.e. it must have been perceived and executed as the required enclosed shape (a diamond, square, circle shape, etc.); exact geometric precision not essential. 1 point. (2) Evidence of motor control, firmness of line. 1 point.	2x4 = 8	0
	Total (includes possible 'bonus' from M.A.)	20	

GENERAL BACKGROUND FACTORS

Child's laterality	Maximum for complete uni-lateral performance, i.e. all right (or all left) is 10 points. 2 points deducted for each item performed on opposite side to the most frequent response. E.g. subject performs 6 items with right, 2 with left; score = 6. "Either" type responses, deduct 1 point.	10	0
Parents' and family laterality	As above, applying to whole family.*	10	0

* Wherever possible give additional familial information, i.e. aunt, uncle, cousin, etc.

Item	Criteria	Maximum score	Minimum score
Family reading and spelling difficulty	Maximum points if no problems reported. 1 point deducted for each report of reading difficulties and 1 point off for each report of spelling difficulties.	10	0
Birth history	Maximum 10 if ordinary birth. 2 points off for each slight risk occurrence, e.g. overdue, premature, pregnancy problems, etc. 5 points off if recorded as 'at risk' birth.	10	0
	Total	40	

For other background factors, see scoring in the Index.

PERFORMANCE ITEMS

Write or copy own name	2 points each for: fluency, order of letters, motor control, writing without copying.	8	0
Visual sequential memory (symbols)	10 items, 1 point off for each one wrong (one symbol wrong = whole sequence wrong)	10	0
Visual sequential memory (pictorial)	10 items, maximum of 2 points for each item. 1 point off for picture in incorrect sequence, 1 point off for picture in incorrect orientation. Maximum of 20. Divide total by 2 to give maximum of 10.	10	0
Auditory sequential memory	Forward digits, 6 items; 1 point off for each incorrect. Reverse digits, 6 items; 1 point off for each incorrect. (1 digit incorrect = item wrong.)	6 6	0 0
Sound blending	20 items; 1 point off for each incorrect item. Divide score by 2 to give maximum of 10.	10	0
Sound discrimination	20 items; 1 point off for each incorrect item. Divide score by 2 to give maximum of 10.	10	0
	Total	60	0

TOTAL FOR INDEX = 120

give additional familial information, i.e. aunt, uncle,

FORM II

Item	Criteria	Maximum score	Minimum score
General Underlying Ability	As in Form I, minus Picture Recognition	12	0
General Background Factors	As in Form I	40	0
Performance items	As in Form I, together with:		
Reading test	This gives Reading Age	-	-
Spelling test	This gives Spelling Age	-	-
Free writing	Reversals, 'bizarre' spelling, motor control, fluency of idea, syntax, punctuation, correct use of capitals, use of clauses, developed vocabulary use, overall competence. 1 point off for each not up to standard (maximum 10).	10	0
Graphomotor subtest	Fluency points from 0-2 for general motor control of pattern.	4	0
	Hand dominance points from 0-2. 2 points if one hand performs much better than the other, 1 point if less so and 0 points if both hands are similar.		
		Total 62	

TOTAL FOR INDEX = 122

In order to plot a 'profile' of ability on the Index, each score is converted to a standardised score out of 10 if not already 10. This applies to Copying Designs and Picture Recognition (out of 8) and Auditory Sequential Memory (out of 12). Conversion tables for this purpose are given below.

Profiles can now be made to give a comprehensive picture of the child's performance levels:

(1) General ability range and attainment compared with chronological age

(2) Scores as diagnostic and predictive items.

For details of this see separate profile sheet.

TABLES FOR CONVERTING RAW SCORES TO STANDARDISED SCORES OUT OF 10

(1) Scores out of 8 to out of 10 (Copying Designs, Picture Recognition)

1	=	1.25
2	=	2.50
3	=	3.75
4	=	5.0
5	=	6.25
6	=	7.50
7	=	8.75
8	=	10.0

(2) Scores out of 12 to out of 10 (Auditory Sequential Memory)

1	=	0.83
2	=	1.66
3	=	2.50
4	=	3.33
5	=	4.16
6	=	5.00
7	=	5.83
8	=	6.66
9	=	7.50
10	=	8.33
11	=	9.16
12	=	10.0

REPORT

JOHN

Date of tests February 1974

Date of birth 4.1.65

C.A. 9 years

John was referred for diagnosis of dyslexic-type written-language difficulties in February 1974.

Assessment yielded the following scores:

General Under-lying Ability ("Intelligence")

Goodenough Draw-a-Man:	11.5 years	
Vocabulary Sub-Test (T. M.)	12.5 years	M.A.
W.I.S.C.	12 years	

Attainments

Reading Age	8.5 years
Spelling Age	8.0 years

Index Scores — Maximum Score = 10

Free writing	4
Graphomotor	5
Visual Sequential Memory (P)	8
Visual Sequential Memory (S)	6
Auditory Sequential Memory	4
Sound blending	4
Laterality	5
Family Laterality	5
Socio-Cultural rating	10
Sequencing Events	4
Sound Discrimination	6

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Standard paragraphs appended to Clinical reports, on the nature of Dyslexia.

The difficulty is categorised by developmental, perceptual disorderings of written-symbolic, combinatorial and sometimes spoken material. The difficulty is acute at the statutory school starting age of 5 years, preventing the child from learning the consistent sequential patterns of English orthography. Difficulties lie in learning phoneme/grapheme correspondences and relating both to meaning. Consequently, no basic experience of written language is 'internalised', on which to build subsequent learning in reading, writing and spelling.

The condition is thought by some specialists to be related to non-resolution of cerebral dominance affecting directional sequencing and arbitrary ordering of symbols; this can be due to constitutional, genetic factors, influences often coming from both maternal and paternal families. These genetic factors are related to ill-lateralised motor and sensory mechanisms in several members of the family concomitant with difficulties in acquiring written language forms. This constitutional difficulty can be exacerbated by 'at risk' birth conditions which can further retard the ability to acquire symbolic learning as well as cause early concentration problems. Secondary anxiety difficulties often arise as the child finds frustrations in being unable to meet the learning requirements of parents and school. The phenomenon is independent of intelligence.

RESULTS

John appears to be in the superior range of underlying general ability as measured by these tests. In reading and spelling however, he is retarded by at least three years.

The Index scores reveal severe difficulties in free writing, auditory sequential memory, sound blending and sequencing well-known events. Difficulties are also present in visual sequential memory for symbols. Motor fluency difficulties are revealed by his performance on the Graphomotor test. The laterality patterns of both John and his family were in the inconsistent range. Socio-economic, birth and affective factors however, rated the maximum score.

OPINION

It would appear from the above results that John's written language difficulties are in the category described by some specialists as dyslexia. Key features are the difficulties in fluency in both motor and sensory modes - especially in auditory sequencing and blending, and in graphic fluency. There would appear to be a strong familial tendency to visuo-spatial ability on the one hand, and difficulty in written language representation on the other. All these factors are characteristic of the dyslexic-type learning pattern. There appear to be no undue stresses from socio-economic and emotional factors, nor any at-risk birth problems.

A well-structured programme of remedial education is advised, based on rules, regularities and the "writing approach to reading". Work would be based on a multi-sensory approach to skill-learning, with special emphasis on auditory sequencing. (Newton, M. Thomson, M, 1974)

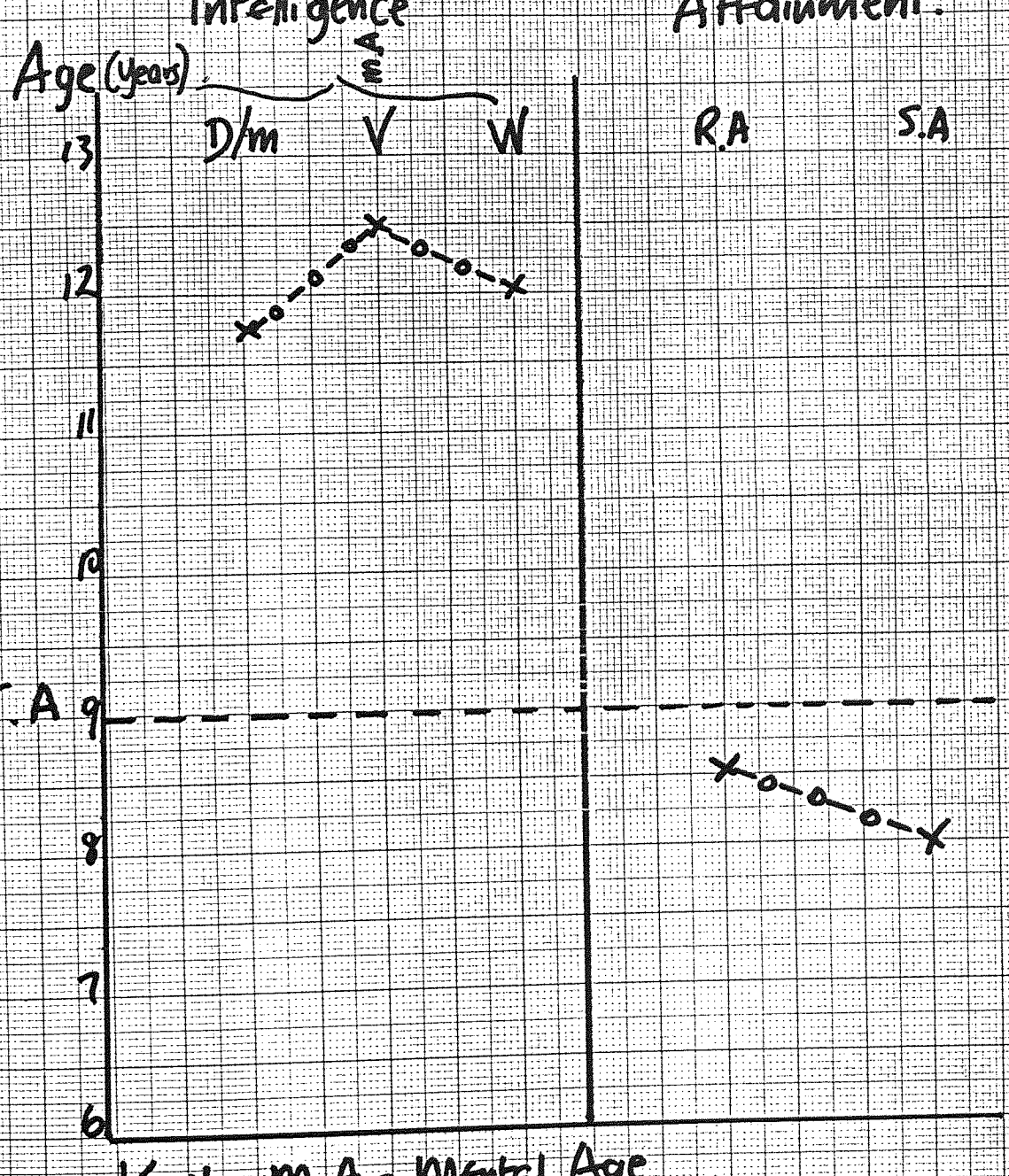
Date: February 1974

JOHN

d. of b: 4. 1. 65

Tester: M.N.

PROFILE of PERFORMANCE (1)

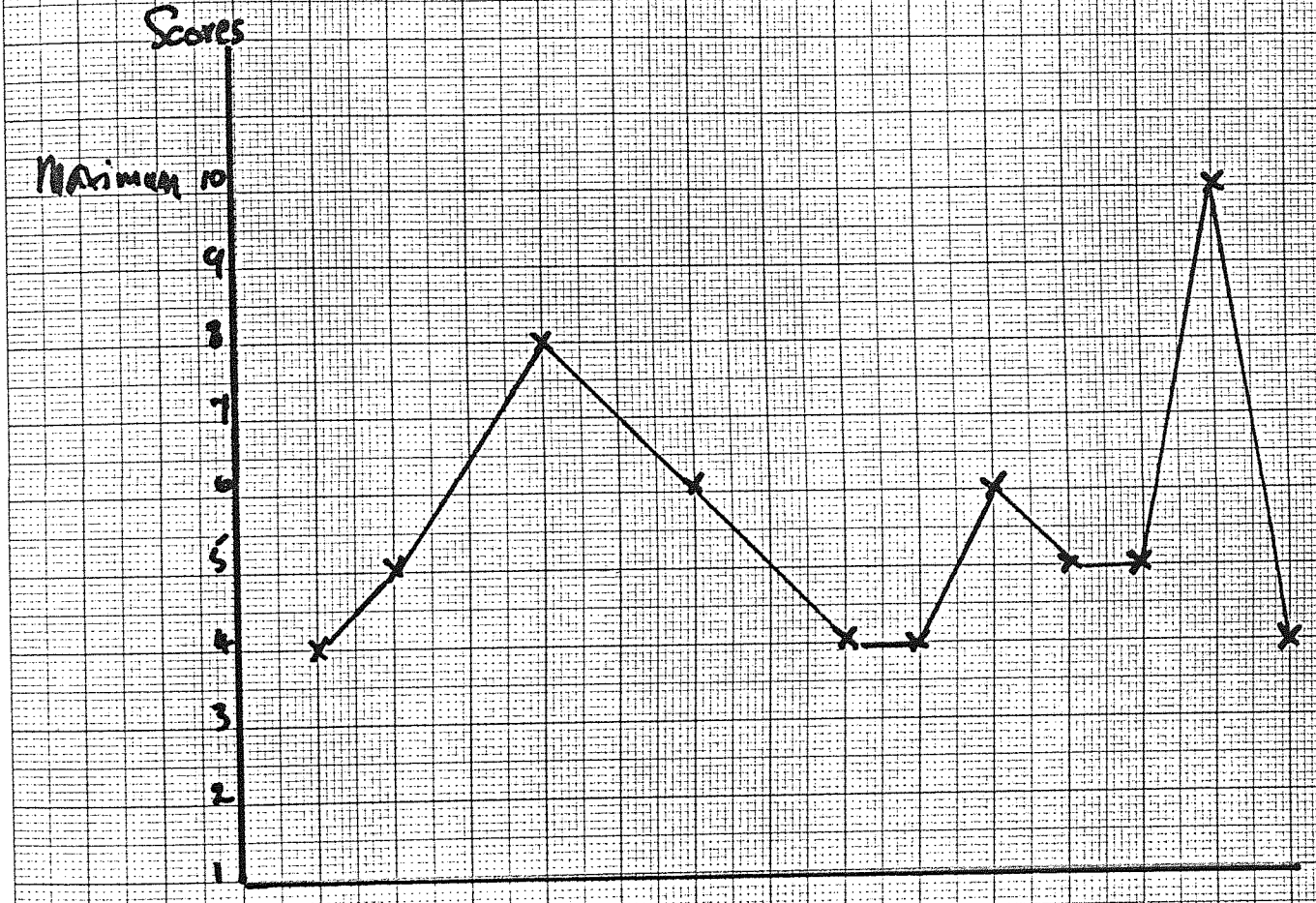


Key: M.A = Mental Age
C.A = Chronological Age
R.A = Reading Age
S.A = Spelling Age
D/M = Goodenough Draw-a-Man Test
V = Vocabulary Sub-test
W = Weschsler Intelligence Scale.

JOHN

PROFILE of PERFORMANCE (2)

F.W G.M V.S.M(P) V.S.M(S) A.S.M S.B. S.D. Lat. F.L. S.C. S.



Key:

F.W = Free-writing.
G.M = Grapho-motor Test
V.S.M(P): Visual Sequential Memory (Pictorial)
V.S.M(S): Visual Sequential Memory (Symbolic)
A.S.M = Auditory Sequential Memory
S.B : Sound Blending
S.D : Sound Discrimination
lat. : Laterality.
F.L. : Family Laterality
S.C : Socio-Cultural.
S : Sequencing Events.

Binet Vocabulary scale; an 'Aston' vocabulary scale derived from a survey of early reading schemes and including the common words found in these; copying a square, circle, triangle and diamond; a 'laterality' questionnaire involving performance of tasks to establish "handedness", "eyedness', "footedness" and "earedness"; knowledge of left and right directions; ability to sequence events (days of week, months of year): visual sequential memory test (pictorial) involving the reproduction of a series of pictures (e.g. mouse, fish, face), each picture of the series being chosen from two mirror images; visual sequential memory (symbolic) involving reproduction of a series of symbols (similar to I.T.P.A.); auditory sequential memory (digit span); sound blending, sound discrimination; graphomotor test involving copying a directional pattern with right and left hands separately in different directions and bi-manually in different directions; and finally a sample of free writing and the Schonell Graded Word Reading and Spelling tests to provide the controlled variables. These items represent measures of "General Underlying Ability", (Vocabulary, Draw-a-Man and copying geometric designs), "Laterality" (Questionnaire, Knowledge of left/right and "Performance" (remaining tests).

6.6.2 Method

The research design was one of matched pairs involving children from schools of differing socio-cultural catchment areas. There were sixty children in each group matched on age, sex and classroom experience. (The children were not matched on intelligence as this was one of the variables examined by the Index). The age range was 7 years to 10 years (mean C.A. = 9.05); Group i, the control group, had reading (and spelling) ages at or above their chronological age (mean reading above C.A. = 1.62 years; mean spelling above C.A. = 0.97 years), and Group 2, reading retardates, had reading and spelling ages at least 9 months below C.A., and in most cases more than this (mean reading retardation = 1.85 years, mean spelling retardation = 2.22 years).

The differences between these groups on the test scores were compared to see if the Index discriminated between them, and correlations were computed between test scores, and between these and reading, spelling and writing scores.

Group 2, reading retardates, were then separated into a 'dyslexic' group on the basis of (a) discrepancy between underlying ability and reading and spelling; (b) discrepancy between vocabulary and written expression and

performance; (c) spelling errors in the nature of mirror-imaging, reversals of words or letters, 'bizarre' spelling, confused ordering of letters, etc; (d) slow reading performance, disordered production of words and letters.

Group 2(a) consisted of 21 children (33.5 per cent of the sample) and were compared with their matched controls (Group 1 (a)). The dyslexic group were $2\frac{1}{2}$ years retarded in reading on average, and 3 years retarded in spelling (controls +1.68 and +1.08 respectively). The means of the remaining reading retardates were also taken.

6.6.3 Results

Table 9 shows the mean scores on the test items for the various groups in the study. The reading retardates scored significantly less than the control group on reading, spelling, free writing, vocabulary, visual sequential memory (pictorial and symbolic), auditory sequential memory, sound blending, sound discrimination, graphomotor test, and totals for "general underlying ability" and "performance". This group also were less well aware of left/right directions and common sequences.

Table10 shows the significant correlations between test items and written language abilities for all the children tested (control and retarded groups). Thus for all children reading and spelling skills are significantly correlated with these test items.

Table11 shows the significant correlations between the various test items for both groups.

6.6.4 Discussion

The results are consistent with previous research (Bannatyne, 1969; Naidoo, 1972; Satz, 1970) and are supportive of the importance of sequential memory, sound blending and laterality in reading and spelling difficulties, and provide concurrent validity for the screening procedure inherent in the Index. From the differences between the groups on the various test items used, it is apparent that the test criteria have measured some significant individual differences in children. Furthermore, these differences separate readers from reading retardates using basic tests that can be administered by the classroom teacher.

TABLE 9 MEANS OF SCORES FROM INDEX (Using ICL statistical Package (XDS3) for Means)

	Reading retardates (whole group)	Dyslexic Group	Retardates without Dyslexic Group	Control Groups		
				Whole Group	Dyslexic Group	Retardates without Dyslexic Group
Chronological age	9.11	9.40	8.95	9.01	(9.7)	(9.02)
Reading age	7.28***	6.68***	7.70***	10.79***	(10.94)	(10.68)
Spelling age	6.93***	6.24***	7.41***	10.10***	(10.31)	(9.96)
Draw-a-man (mental age)	8.65	8.35	8.85	8.96	(8.94)	(8.97)
Stanford-Binet vocabulary (vocabulary age)	9.49**	10.15	9.04**	10.87**	(10.92)	(10.84)
Aston vocabulary	9.38**	10.04	9.02**	10.79**	10.92	10.71
Copying designs (max score 8)	6.22	6.08	6.32	6.78	(6.75)	(6.79)
Laterality (max score 10)	4.97***	3.67	5.88***	8.05***	(8.01)	(8.21)
Visual sequential memory pictorial (max 10)	5.84***	5.48***	6.09**	7.83***	(8.10)	(7.63)
Visual sequential memory symbolic (max 10)	6.55**	5.92***	6.41**	8.14**	(8.21)	(8.09)
Auditory sequential memory (max 12)	8.83***	8.17***	9.92**	10.69***	(10.37)	(10.91)
Sound blending (max 10)	7.02**	6.42***	7.44**	8.02**	(7.87)	(8.19)
Sound discrimination (max 10)	9.19*	9.53	9.09*	9.97*	(10.00)	(9.98)
Graphomotor (max 4)	1.50*	1.37**	1.58*	2.74*	(2.79)	(2.70)
Free writing (max 8)	2.59***	1.75***	3.18***	6.67***	(6.87)	(6.63)
Total score for 'underlying ability' (max 10)	6.22*	7.23	6.07**	7.59	(7.54)	(7.62)
Total score for performance items (max 64)	40.94***	37.42***	43.43***	53.78***	(53.54)	(53.79)
Knowledge of left/right - percentage showing directional confusion	60%	90%	30%	10%	(9%)	(11%)
Months of year in sequence - percentage of sample failing	71.5%	80%	36%	9%	(10%)	(11%)

* Difference between this score and control group significant at $p < .05$ level)
** " " " " " " " " " $p < .01$ ") from Students 't'
*** " " " " " " " " " $p < .001$ ")

Other scores are not significantly different (between experimental and control group)

TABLE 10 SIGNIFICANT CORRELATIONS BETWEEN READING, SPELLING AND FREE WRITING AND TEST ITEMS (Both groups all children)

	Reading Age	Spelling Age	Free writing
Stanford-Binet vocabulary	.61	.55	.48
(Aston vocabulary)	(.60)	(.55)	(.47)
Laterality	.54	.55	.54
Visual sequential memory pictorial	.59	.63	.60
Visual sequential memory symbolic	.69	.71	.65
Auditory sequential memory	.61	.59	.59
Sound blending	.41	.42	.31
Sound discrimination	.33	.36	.25
Graphomotor	.57	.55	.60
Total general underlying ability	.42	.39	.36
Total performance	.84	.87	.86

TABLE 11 SIGNIFICANT CORRELATIONS BETWEEN TEST SCORES (BOTH GROUPS) (Using ICL Statistical Package (XDSE) for Correlations

	Dam	SB voc	CD	Lat	VSMP	VSMS	ASM	SB	SD	GM	GUA	PT
Draw-a-man		.46	.46								.63	
Stanford-Binet Vocabulary	.46		.33		.42	.36	.37	.39			.52	.52
Copying designs	.46	.33									.85	
Laterality					.40		.38			.35		.53
Visual sequential memory pictorial		.42		.40		.64	.62	.31		.40		.80
Visual sequential memory symbolic		.36			.64		.45			.39		.74
Auditory sequential memory		,37		.38		.45		.37		.44	.30	.75
Sound blending		.39			.31		.37		.35		.37	.54
Sound discrimination								.35				.40
Graphomotor				.35	.40	.39	.44					.56

Stanford-Binet vocabulary and Aston vocabulary .92 correlation.

In the reader/reading retardation group, all the items discriminated between the two groups except for theGoodenough Draw-a-man and the Copying Designs. The factors involved would thus seem to be a combination of vocabulary, or understanding of language itself (for whatever reason), and the performance items relating to the nature of the subskills involved in reading.

The dyslexic subgroup, however, show only differences in the performance items, which may be indicative of a 'purer'set of difficulties relating to sequencing skills. The fact that the two groups of poor readers both show deficits in these performance items seems to suggest a fundamental set of difficulties inherent in the learning of graphic script which are more severe in the dyslexic group, thus affecting their written language more obviously in terms of clinical observations. Knowledge of left and right and reproducing the months of the year in sequence also differentiate between the two retarded groups, relating to body image/directionality and sequencing.

This is also supported by the correlations that the test items show with reading, spelling and free writing ability; although interpretations of a causal nature should be approached with caution, one or two points arise from these. Reading and spelling ability are correlated with vocabulary and may relate to intellectual as well as linguistic abilities. What is more interesting is the high correlations with sequential skills of a visual (visual sequential memory), auditory (auditory sequential memory) and motor (graphomotor test) nature. Sound Blending also has elements of auditory memory, as the sounds must be retained before being 'blended'. These skills can be related directly to written language which is sequential (letters and words must be placed in a sequence), directional (many letters have mirror images), ordered (incorrect orders change meanings), arbitrary (not relating to the concrete event) and symbolic (reflect concepts and not images). Thus in order to retain, store, reproduce and perceive this system, these types of skills are required. At another level, it is apparent that the variables used and reading (and spelling) are linked and improved function on one variable may give rise to improved function

on the other. The above suggests a possible explanation for this correlation.

The correlation of laterality with reading and spelling is of interest. The studies on this subject have often been contradictory (Critchley, 1970). In this study the correlation is probably due to the more sophisticated measures used (i.e. 'laterality' cannot be measured by the hand which writes as is the case in some research, but by the constellations of handedness and sensory mechanisms in various tasks). Dichotic listening techniques appear to be the most valid way to investigate this hypothesis, and studies are increasingly being reported using these (Bryden, 1970; Satz et al, 1965). A causal hypothesis to explain this correlation may be suggested, in that unilateral dominance of sensory and motor functions may be the most efficient pattern by which to acquire the sequential and combinatorial skills required in written language. Inconsistent patterns of lateral dominance may not be so efficient, and could give rise to difficulties in these skills (but may predispose to ability in others e.g. spatial (Newton, 1971). These findings are not inconsistent with the 'cerebral dominance' hypothesis of dyslexia (Orton, 1937; Satz, 1970; Newton, 1973) described earlier in the thesis.

The high correlation between the overall test score and reading and spelling is again an indicator of the validity and relevance of these items as a screening procdure for use with all children, but particularly to identify dyslexic type difficulties - examination of the means for the performance items shows the dyslexic group with greater difficulties in the skills measured. The dyslexic group also show greater difficulties in reading and spelling, as well as no difference between this group and controls on vocabulary.

The characteristics of the skills investigated by the Index are examined to some extent by the intercorrelation between test items. (No attempt has been made at factor analysis as numbers are too small; in any case the individualistic nature of these make factor analysis in other studies inconclusive (Naidoo op cit). As expected, the "underlying ability" items - vocabulary, copying designs and Draw-a-man - tend to correlate, although vocabulary also correlates with other

performance items. Also the "sequential memory" items, and the "auditory" items tend to correlate.

There are important implications for teachers and others concerned in the learning of children. Diagnostic items that may be used in the classroom can lay a firm base to building remediative programmes. Test profiles of the nature described above may point to areas of weakness requiring training, or ways of circumventing, and areas of relative strength that may be built upon. The indicators of a dyslexic type difficulty suggest a different approach of attitude and teaching (Newton and Thomson, 1974), whereas, say, slow learning or vocabulary difficulties have their own concomitant approaches to teaching. The approach generally is one of investigating the intrinsic skills that children bring with them to the task of reading and spelling, and how these skills match up with those required for written language. When there is a 'mismatch' of these skills, remediative intervention is necessary. This may present the written language in a way that is compatible with the child's own individual learning patterns.

The results from this first validation exercise supports the hypothesis derived from long observation in teaching and clinical situations, viz. that the dyslexia category of learning difficulty could be diagnosed in the classroom; that given an index of items which represent the observed symtomology, the class teacher could be made aware of such differing developmental patterns. Once awareness was established, appropriate teaching could be planned.

6.7 THE FIPST STAGES OF A PREDICTIVE STUDY

In this investigation Form I of the Index was used. The study represents the beginnings of a longtitudinal survey in which the same children will be examined first when they are in the age-range 5 years 6 months to 5 years 9 months and secondly in two years' time. Thus a measure of the predictive validity of the Index will be obtained;

the hypothesis being that children with low scores on various subtests, or on overall performance, will have difficulty in acquiring written language, whereas children scoring high will do well in written language.

6.7.1 Procedure

Form I of the Aston Index as described was administered to 131 children between the ages of 5 years 6 months to 5 years 9 months inclusive as already described. These were taken from six different schools from different areas of a local authority, representing varying socio-economic levels, and included all the children of that age group in the school.

6.7.2 Results

	Mean	
Draw-a-Man test	5.63	(chronological age)
Terman-Merrill vocabulary sub-test	5.94	(mental age)
Aston vocabulary	7.15	(vocabulary age)
Copying geometric designs	7.00	(vocabulary age)
Picture recognition	4.64	
Laterality	7.75	
Visual sequential memory, pictorial	6.05	
Visual sequential memory, symbolic	5.27	(orientation)
Auditory sequential memory	4.13	(sequence)
Auditory sequential memory, reverse	7.86	(4 digits forward, 2 reverse)
Sound blending	2.30	
Sound discrimination	3.67	(3 sounds)
Copying name	9.12	
Underlying ability total	5.21	
Performance total	13.22	
Visual memory symbolic	38.06	
	6.53	(3 symbols)

6.7.3 Significant correlations between various test items

See Table 12

6.7.4 Discussion

At this stage no conclusion can be drawn from the value of the Index in isolating the 'at-risk' child at an early age, but one or two observations may be made:

(i) there is a great spread in the test scores on the various test items, indicating that meaningful individual differences are being

TABLE 12 SIGNIFICANT CORRELATIONS BETWEEN VARIOUS TEST ITEMS (Using ICL Statistical Package (XDSE))

	Dam	SB Voc	As Voc	CD	PR	LAT	VSMP	VSMS	ASM	CN	SB	SD	UAT	PT
Goodenough Draw-a-man test (Dam)		.270	.229						.267	.249		.205	.451 *	.271
Stanford Binet Vocabulary Scale (SB Voc)	.270		.767**				.246	.294	.396		.346	.341	.380	.416*
Aston Vocabulary Scale (As Voc)	.229	.767**		.223			.317	.324*	.4023		.373	.375	.377	.458*
Copying Designs (CD)			.223			.224		.244	.300	.521**	.232	.211	.855**	.418*
Picture recognition (PR)													.246	
Child Laterality (Lat)				.224			.478*	.334	.328	.307				.387
Visual sequential Memory Pictorial (VSMP)		.246	.317			.478*		.553	.431*	.306	.286		.241	.659**
Visual sequential Memory Symbolic (VSMS)		.294	.324	.294		.374	.553**		.479*	.398	.376	.220	.323	.724**
Auditory sequential Memory (ASM)	.269	.396	.402*	.300		.328	.431*			.409**	.532**	.287	.396	.776**
Copying Name (CN)	.249			.521**		.307	.306	.398	.409*		.405*	.222	.554**	.667**
Sound Blending (SB)		.346	.373	.232			.286	.336	.552**	.405*		.281	.337	.767**
Sound Discrimination (SD)	.205	.341	.375	.211				.220	.287	.222	.281		.295	.426*
Underlying Ability Total (UAT)	.451*	.380	.377	.855**	.246		.241	.323	.369	.554**	.337	.295		.512**
Performance item total (PT)	.271	.416*	.458*	.418*		.387	.659**	.724**	.776**	.667**	.767**	.426*	.512**	

* Significant at $p > .01$ level; ** Significant at $p > .001$ level: All others significant at $p > .05$ level

measured. This has important implications for the individual differences in some skills that children have, but are not necessarily being observed by teachers. For example, children range between 0/10 and 9/10 on remembering symbols in a sequence and from non-existent to up to 4/5 sounds in sound blending skills (at $5\frac{1}{2}$ years old). Children also vary between very inconsistent patterns of handedness, eyedness, etc. (laterality), represented by 0 on the scoring system, to all consistent patterns (10 on the scoring system), the 'average' child having some small inconsistencies,

(ii) Arbitrary cut off points may be used to divide 'at-risk' and other groups on the basis of their test performance.

(iii) The use of the Aston vocabulary scale can be continued on an experimental basis as this shows a high (.767) correlation with the Stanford-Binet scale.

(iv) Many of the performance items correlate highly with each other and with the performance total, and may thus represent some similar "factor". This is particularly true of the auditory sequential memory sub-test.

(v) Vocabulary and copying designs also are correlated with performance item totals and thus underlying ability may not be completely independent from these tests, although "copying name", the only measure of written language in the battery, does not correlate with vocabulary.

As in the concurrent validity study, these results appear as favourable indicators that dyslexic signs are present in the class-room situation and can be observed by the trained and prepared teacher. The Index could be one instrument to focus the observation. It was devised by the writer from theoretical, empirical, clinical and observational experience as a first step on the way "towards diagnosis"; the second step must be to test the hypothesis by its scientific use in the field. The results of these two first experiments would appear to bring the possibility of early screening that much nearer. It is hoped that post-doctoral research will continue the longtitudinal study until the final stages of authoritative diagnosis are reached.

6.8 FIELD STUDIES

Two thousand copies of the Index are in current use throughout Great Britain and other English speaking countries. Teachers first attend short courses in its administration, scoring and interpretation. They subsequently use the Index in various school settings, e.g. infant junior, secondary-modern, comprehensive, E.S.N. and E.S.S.N. The Index has also been used in grammar schools and University departments in cases of puzzling incompetencies in written fluency. The Department of Employment is also involved in its use. Data from all these field trials is sent to the Language Development Study Team to be analysed after two years time. Again both predictive and diagnostic stages are being investigated. The data is accompanied by verbal reports and by appraisals of the screening procedure.

6.8.1 First stage of 'field'validity

The performances of sixteen children described by teachers as having dyslexic reading difficulties were compared with those of a matched control group - children who were succeeding normally in language skills. The age range was $7\frac{1}{2}$ years - $10\frac{1}{2}$ years. The referral group was on average over 2 years retarded in reading and spelling, the control group being 6 months above chronological age in reading and spelling. There were no significant differences between the two groups on vocabulary age (Stanford-Binet) or mental age as measured by the Goodenough Harris Draw-a-Man test.

The test items were:

Laterality questionnaire
Family laterality questionnaire and birth history

Sample of free writing
Visual sequential memory
Auditory sequential memory
Sound blending
Sound discrimination
Graphomotor test (copying directional pattern)

The referral group scored significantly less on the visual sequential memory (Mann Whitney U test $p < 0.05$) and the auditory sequential memory (Mann Whitney U test $p < 0.05$) and were significantly less well lateralised (Mann Whitney U test $p < 0.02$), with more 'at-risk' family

histories. The free writing of the referral group was also poorer as judged on the following criteria: reversals; 'bizarre' spelling; motor control; fluency of idea; syntax, punctuation, correct use of capitals, use of clauses, developed vocabulary; and overall competence. There was no significant difference between the groups on sound blending or sound discrimination; (although, clinically, poor performances on these tests were indicative of very severe difficulties in reading andspelling). The graphomotor test was judged on motor control and fluency as well as the difference in performance by each hand (an equivalence reflecting equal handedness on this task). The referrals showed a higher incidence of lack of motor fluency (70%, controls 55%) and a higher frequency of equivalent hand performance (65%, controls 52%).

6.9 CLINICAL STUDIES

The Index has been in use during the last two years in the Diagnostic and Advisory Clinic in the Developmental Language Study Centre in the Applied Psychology Department of the University of Aston. Positive diagnosis of dyslexia has been made in one hundred and fifty cases during that time (i.e. dyslexia as defined by the criteria described in this thesis). Children and adults presenting with the critical features of the syndrome have in all cases been identified by performances on the sub-tests of the Index.

6.10 CONCLUSIONS

All these investigations have yielded results which support the underlying hypotheses of the thesis: that a primary difficulty exists, characterised by intrinsic, developmental patterns in individual cognitive styles; that it involves representational modes of symbolic graphic form; that characteristic features of performance in these modes are present in operationally defined dyslexic subjects; and that it is possible to detect the difficulty by a selective battery of test items. Thus the present version of the Aston Index represents a major step forward on the way towards diagnosis.

C H A P T E R S E V E N

CONCLUSIONS

7.1 RECAPITULATION

The term "dyslexia" is increasingly used throughout the world to describe an extreme difficulty in acquiring the fundamental skills of written language in normally functioning people. The term has been defined by the World Federation of Neurology (1968) as:

"a language disorder in children who despite conventional classroom experience, fail to attain language skills of reading, writing and spelling commensurate with their intellectual abilities".

The difficulty has been reported as affecting from 4 to 40 per cent of populations in societies where a phonetic alphabet is used. This type of alphabet system demands highly organised directional, arbitrary symbolic skills. Increasing evidence indicates that this requirement can be incompatible with developing patterns of sensory, motor and language mechanisms in the young child of school age. Could the reported high illiteracy rates, despite sophisticated educational techniques be causally related to this incompatibility? The issue is examined historically and in the light of recent research.

7.1.1 Historical context

As long ago as 1873, the German neurologist Kussmaul was using the term "alexia" to describe speech and language disorders caused by trauma to the dominant left hemisphere of the brain. It was in 1856 that Broca had referred to the left hemisphere of the brain as the dominant hemisphere because of its pre-eminence for language function. In 1877, Professor Berlin used the term "dyslexia" to describe a similar phenomenon of loss of language function due to cerebral incident. James Hinshelwood, a Glasgow eye-surgeon, described a similar condition, but without brain trauma, as congenital word-blindness, an expression which became synonymous with the word "dyslexia". Hinshelwood wrote in the Lancet and other medical journals of the day about this condition which occurred in people with otherwise normal undamaged brains, but which appeared to be related to a particular area in the left or dominant hemisphere. Since this time special reading difficulties in persons of normal intelligence have been recognised by neurologists in many parts of the world. However,

their use of the term "dyslexia" to describe a particular category of reading difficulty has not been accepted by educationists (e.g. Tizard).

7.1.2 Educational context

Causal factors for this rejection by educationists can be traced historically to the pioneering of educational psychologists such as Burt and Schonell in the 1930's and 1940's who uncovered the overwhelming nature of environmental stresses in the backgrounds of many children which prevented them acquiring formal language learning in school settings. These are described by Vernon (19) and include socio-economic deprivations, ill preparing the child for a verbally based education; emotional trauma within the family with consequent inhibiting anxiety effects;and inadequate school situations.

Although the limiting factor of "slow-learning" intellectual potential has also been recognised, the emphasis over the last 25 years in the educational decision-making bodies has been on these former extrinsic factors. Educational opinion has been hardened by the medical use of the term "word-blind" as a synonym for "dyslexia". "Word-blindness" can suggest an irretrievable, irremedial situation, such as colour-blindness and it was feared that such children could be written-off educationally. The controversy over the use of a term still continues and consequently diverts attention from the fundamental issues of the individual child's problem.

7.1.3 More recent approaches

There have emerged, however, some neurologists and psychologists who have been investigating the phenomenon in the whole context of the young child (in his environment), and with his own developing skills meeting the written language. A notable contribution was made by Orton who introduced the concept of cerebral dominance into the field of reading,spelling and writing. He realised that underlying central nervous system organisations could affect perceptual, motor and language skills, and that remedial programmes therefore could be made compatible with these individual differences in development.

Orton described the underlying features of "dyslexia" as 'difficulties in acquiring series', or in 'looking at random' and associated their occurrence with unstable patterns of individual laterality i.e. some inconsistencies in right and left sidedness in hand, eye, ear and foot etc. He related such patterns to hemispheric control of these functions and referred to the problem as one of cerebral dominance. These patterns of laterality, both in the brain for language, and for sensory/motor mechanisms have been the subject of much neurological and psychoneurological research in the last two decades, e.g. Zangwill, 1971; Critchley,1964; Kimura, 1973; Sperry, 1967; Geschwind, 1962; Luria, 1964 whose work has been explained earlier in the text. All these research workers have isolated features of differential functioning in the brain. It would appear that language, symbolic order, analytic and discrete skills are processed in the left hemisphere whereas global, visuo-spatial and artistic skills have a pre-eminence in the right hemisphere. The above localisation of function would be the constellation for the right dominant individual, whereas the left or ambi-lateral person could have these skills subserved at random in either or both hemispheres.

Other research workers have studied the probable distribution of left, right and ambi-lateral people in the population furthermore these individual differences in handedness (laterality) have been related to differences in learning. One such major difference is in the field of written language and many researchers have described the high incidence of ill-lateralised persons with specific reading difficulties (e.g. Naidoo,1972; Klasen, 1972; Bannatyne, 1971.)

The difficulties in reading and spelling arising from such inconsistent laterality patterns are described as being in the nature of reversals, mirror imaging, disorders of spelling, slow reading, regressive eye movements, non-fluency of direction, "bizarre" spelling, apparent difficulties in short term memory for strings of phonemes and graphemes and extreme difficulty in written expression. These difficulties are frequently related to maturational lags in establishing leading or dominant patterns of function (Ajuriagerra, 1964; Satz, 1972) often preventing the beginner-learner from "catching" the system. Other workers find that residual

adult patterns of spelling and writing inability persist when reading itself has been achieved, especially under stress. In some cases although the skills of reading and writing have been acquired, a slow and non-fluent pattern is still observed in their work. These patterns of laterality and written, sometimes spoken, language difficulties are often present in other members of the family as well as in the referred cases (Critchley, 1970; Hallgren, 1950). Another interesting phenomenon in these families is the high incidence of good visuo-spatial ability and consequent success in engineering, architecture, art/design etc. (Bannatyne, 1966; Newton, 1971), in contrast to their poor performance in the written literary skills. Is there some causal mechanism linking hemispheric differences in the brain to man's individual skills - and, if so, how can it be investigated?

7.1.4 Towards an integrated approach

All these aspects: a) cerebral dominance in the central nervous system b) laterality of motor and sensory mechanisms c) disabilities in sequencing and directionality d) genetic aspects in families have been recognised then by many research workers as being in some way connected to the acquisition of written language, where this latter is based on an alphabetic, sequential, directional and arbitrary symbolic system, as in the English (or other western) orthographies.

Although some form of vocal language is probably co-eval with the emergence of man himself, written language is a comparatively recent form of communication, perhaps 3,000 to 4,000 years old. Yet most countries in which universal literacy is sought after base their educational programmes on the written word. There is an almost automatic assumption that, apart from gross defects in development, every child will acquire competence in written language forms. Dismay and unease are regularly expressed by educationists and the rest of society when figures of illiteracy varying from 10 per cent to 30 per cent are published.

Specific features, therefore, of symbolic written language in relation to developmental aspects of growth in perceptual, motor and language mechanisms need to be investigated.

The writer has worked within this integrated framework to establish first the specific category of difficulty defined by many as "dyslexia"; and secondly,

having isolated such a phenomenon, to devise a diagnostic instrument for use in early stages of learning.
This instrument has been designated the Aston Index. It consists of a representative index of items from the array of possible determinants of a dyslexia syndrome as described in this thesis. Three main areas are examined viz:

general underlying ability ("intelligence")

child and family history; including laterality socio-cultural settings; birth history and the family competence in written skills

performance items related to reading, writing and spelling.

The Index is designed to cover three contingencies: the first when a child has been attending school for six months or so and when the teacher has noticed discrepancies between his apparent social and verbal competence and his expected attainment. This is the predictive stage. Secondly a form is devised for administration at 7+ years for puzzling cases of non-attainment. This is the diagnostic stage proper. Thirdly a clinical instrument for use by Consultants and specialists is described in cases where such a resistive learning difficulty is present that further, deeper diagnosis is necessary. The items are based on well-documented underlying theory. Instructions for administration, scoring and interpretation are written in accordance with the techniques of traditional psychometric method. Scores derived from the items yield a 'profile' of the child's potential in the appropriate areas of skill and development. As well as concurrent validity trials, longtitudinal studies are in progress to discover whether such profiles will yield a 'threshold' score of vulnerability to primary written language difficulty. It is postulated that such a score would indicate to the teacher in the classroom which children are 'at-risk' in the formal, ordered, symbolic aspects of language learning, also it would indicate the troughs and peaks of individual ability in the various component tasks of reading etc. Upon such information the teacher could then devise appropriate first teaching

or later remedial teaching. Written language can then be presented in ways compatible with each child's own individual learning patterns. The long term aims of devising the Index for class-room use are several: the class-teacher will have the power to observe and understand the underlying readiness stages of all individuals entering formal education. At least some of the present confusion over the fundamentals of written language learning might thus be cleared. When attention is focussed on individual areas of difficulty, appropriate teaching steps can be taken and dyslexic children will then have the maximum opportunity to acquire the necessary techniques and skills demanded by the system. Not only will the cognitive aspects of a child's development be fostered, but the self-concept, personality growth, social competence, independence and maturity will also be nurtured; whereas anxiety,failure, frustration, loss of effectiveness as a person, in some cases delinquency and deviant behaviour will be minimised. The optimistic hopes of the 1870 administrators for 'universal literacy' might be nearer realisation, if education could begin in a realistic and appropriate setting.

The present stage is one of "towards diagnosis of dyslexia". It has been arrived at after long educational and clinical observations and a review of related theoretical writings. The writer looks hopefully to the final stage in two years time and the completed realisation of the work i.e. the publication and dissemination of a substantiated instrument for class-room prediction and diagnosis of dyslexia.

7.2 FINAL DISCUSSION

Internationally, at the time of writing, increasing attention is being paid to the problem of dyslexia. But it is as yet little understood by the public - and indeed by many advisers on educational policy. In this thesis the writer sets the phenomenon in a general context of child development, educational practice and neuro-psychological and linguistic theory.

The powers of environment and intellect in setting up barriers to school learning have been widely recognised in educational practice. Yet to some present day research workers these barriers would, in some cases, be seen as secondary factors. A prime factor, involving intrinsic developmental patterns has been isolated and described by many neurologists and neuro-psychologists. It is neurological in origin and involves individual differences in the development of sensory mechanisms i.e. visual and auditory perception; motor mechanisms (especially handedness) and laterality of brain hemispheres for language function. When there is unevenness of development between these functions and/or symmetrical ambilateral function in place of dominance, difficulties of unstable perceptual patterns can arise which prevent the consistent learning of order and direction - visually, auditorily and graphically; in any one mode or in any combination of modes. Sometimes the consequent difficulty in 'symbolia' or 'flash of recognition' is a result of maturational lag; it will be resolved at eight, nine or ten years or some even later stage. It is often a genetic familial growth pattern, seen in other family members. Sometimes it is a condition caused by an 'at-risk' birth, pre-, peri- or post-natal in origin; or it can be an interaction of both causes. It is estimated on a probability distribution amongst the population that as many as 28 per cent of children entering school at the statutory age of five years could be 'at-risk' within this category, minimally or grossly affected. Observable signs in the individual child of inconsistent sensory, motor and language functions are often discrepant patterns of left/right eye, hand, ear, foot organisation - sometimes described as 'lacking cerebral dominance - the child looks at random; he cannot acquire series'. In cases where the secondary environmental or intellectual stresses are also present, formidable barriers against ordered, symbolic learning must be overcome - especially in the very young learner. To the writer this category of learning difficulty is defined at the present time by the term 'dyslexia'.

If such a model exists, substantiated by authoritative evidence from neurology and neuro-psychology, what is the cause of the present confusion in the fundamentals of written language learning - of the inertia in high places? How is it possible for educational advisers to report to the Department of Education:

"The term dyslexia has been very loosely used in educational contexts and we do not consider it can usefully be employed for educational purposes"

On the one hand and for the Department of Employment on the other to set up a working party to investigate the problems of the dyslexic adult? A serious aspect of this confusion is highlighted by the published report of this working part (Pammenter, 1974). The editor writes:

"The need for a Working Party to look into the problems of the dyslexic adult arose as a result of the increasing number of students coming for help to the Preparatory Training Bureau of the British Council for the Rehabilitation of the Disabled. Youngsters who had been considered illiterate or backward when leaving school had come up against the problem of "form-filling" when seeking employment.....
Some youngsters found their way to the Department of Employment where during preliminary tests they were found to be dyslexic....."

The educational system had not recognised the dyslexic problem, but upon leaving school they were 'disabled young people', dyslexic people!

Could the educational advisers to the government be overwhelmed by an idée fixe - or that well-known psychological phenomenon - stereotypic thinking? After the 1950's because so many case histories of retarded children yielded data of socio-economic or emotional deprivation, was all failure which was not due to low intellectual functioning or gross neurological deficit attributed to such extrinsic causes? Is it a case of 'birds and feathers' (Kabriski, 1964) - a modern allegory in which a turbo-jet aircraft, after being seen in flight by a primitive tribe, crashed near its village. Flight to these primitives meant feathers; so a hundred years of research was begun to find the equivalent of the feathers which had presumably powered the great bird.

Because so many case histories of retarded children yielded data of socio-economic or emotional deprivation, was all failure which was not due to lowintellectual functioning or gross neurological deficit attributed to such extrinsic causes? The writer recalls again her own clinical experiences, when case records were searched for stressful environmental factors and all treatments were planned upon these basic premises. Eventually the overwhelming evidence of some other, intrinsic, causation led her to begin the ten years of study which have resulted in this thesis.

Failure to resolve learning difficulties in many cases had to be acknowledged. Other neurological, intrinsic, factors were repeatedly observed which in themselves constituted a syndrome, a symptomology, a category of event.

This thesis has explored the key factors in this category which have led the writer to set up the model of 'incompatibility' which was described at the beginning of the chapter. But before another kind of self-perpetuating system, with its own persuasive features of internal consistency, is accepted with dogmatic partisanship, it would be well to examine again its proposed underlying dynamics; to check that apparent linkages lock together in feasible working order, so to say.

The issue may not be as straightforward as it appeared in the opening paragraph of this chapter. It is confounded by the differing training, attitudes and perceptions of the main protagonists. Again there are the many differing terms which are brought together into one model of learning - laterality, development, perception, motor activity, language, learning etc. Each term represents in itself a whole area of acquired knowledge. The areas themselves are frequently represented by differing levels of analogy or reality e.g. biological functions, psycho-linguistic functions, observational, developmental theory etc. Some of these events derive from actual scientific data or from known medical or neurological fact; others are from behaviour models, empirical education or rational deduction. A key problem of attempting a global, an integrated approach to a complex human phenomenon lies in the differing levels of current understanding in the constituent parts.

Three notable areas of controversy in the present phenomenon are language acquisition in man, the concept of laterality as applied to language and other skills and its role in the neurological functioning of the central nervous system.

One of the first points to be recognised and pointed out by linguists is that of the primacy of spoken language, which as Lenneberg suggests can be viewed as the 'first symbol system'. In simple practical

terms this means that children acquire an oral vocabulary before proceeding to a written language.

Differing views on the nature of this acquisition have been discussed in Chapter 2.

Written language which is developed from oral language is alphabetic. Most speech sounds (phonemes) are represented by arbitrary symbols (graphemes). These, unlike picture writing, or Chinese pictogram (word writing) are symbolic and unrelated to the actual events in the environment. An illustration of this is given by Bloomfield (1942):

"As an illustration we may take the written representation of the word 'pin'. In consists of three characters, and each of these three represents a single phoneme. If anyone told us to use these three characters to represent the word 'needle', we should find the suggestion absurd, because these characters do not fit the sound of the word 'needle'. That is, each of three characters, 'pin', is used conventionally to represent a unit sound of our language. This appears plainly if we compare the written symbols for other words, such as 'pig', 'pit' or 'bin', 'din', or 'pan', 'pun', or if we reverse the order of the letters and read 'nip'.

The alphabetic nature of our writing appears most plainly of all, however, when we put together a combination of letters that does not make a word and yet find ourselves clearly guided to the utterance of English speech-sounds; thus nobody will have trouble in reading such nonsense-syllables as 'nin', 'nip', 'lib'."

Our system then is not a picture writing system, or a pictogram (word writing) system, but a symbolic one in which the graphemes are unrelated to the actual event in the environment. This alphabetic system is then expanded into word patterns and also spelling patterns, or as Fries (1962) calls them, sequences of phoneme contrasts and sequences of grapheme contrasts respectively. Each language has its own permitted patterns (digrams, trigrams) which must be learned as arbitrary rules of the system, e.g. ing, and, ch. At another level it has been pointed out by many linguists that there is no direct relationship between surface structure and meaning, and in written language one therefore has the distinction between word (or letter) identification and reading for comprehension. Smith (1973) describes 'mediated word indentification' in which the

composite letters are discriminated, and the sound of the word is built by the phonic/spelling rules, and 'immediate word indentification' in which the marks on the paper are transposed into meaning directly. He suggests the former process is used by learners, and the latter by fluent readers. The problem for the learner therefore is the question of what are the distinctive features for discriminating the inkmarks. Some are more similar than others, e.g. b-d-h or nv. Furthermore many of these inkmarks are directional, mirror-imaged or transposable - p-q, b-d, m-w, u-n. (The environmental event represented by the word however remains the same whether turned around, upside down, etc. or not, whereas our symbol system changes its meaning.)

An extension of this, and relating to the points made on word and spelling patterns is that written language is sequential; letters and words being put into a sequence and a correct order. Thus the distinctive features or constituent letters of cat and act, or was and saw are the same, and therefore the differences relate to meaning, rather than perceptual features.

Different written systems might not produce difficulties of this nature, but only a script system involving an alphabetic, phonemic code. Pecent evidence looking at Japanese scripts is supportive of this. Makita (1974) describes two types of script - Kanji, which is a pictogram system, carrying the meaning at once (as Smith suggests fluent readers do with our system) and Kana, which is alphabetic. Dyslexia is reported as being of much higher incidence in children who are taught the Kana script, with the same clinical features reported. It would appear that future work in this field could usefully pursue two areas of study: i) the implications of differential functioning in the brain - a task for the neuropsychologist and ii) a deeper investigation of the fundamentals of written alphabetic script form and the consequent effect upon the acquisition of such scripts - this would be a task for the applied linguist.

The second area of controversy is that of laterality in man, especially in relation to handedness, 'earedness' and eyedness. Kinsbourne (1972) employing measures of head and eye turning as indicators of cerebral

dominance was led to the following tentative conclusions:

1) Right handers: language processes are left lateralised and spatial skills more evenly distributed but emphasised in the right hemisphere
2) Left handers: dominance of right and left hemisphere for language functions is approximately equal, with spatial functions also being controlled with equal frequency by either hemisphere.

Kimura (1967) found that relative scores for right and left ear reflected specialisation of function between the brain. It was known that right temporal lobe damage could lead to perceptual deficits involving quality and pattern of tone. On a dichotic listening task it was discovered that melodic patterns were better recalled and matched, when presented under simultaneous conditions to the left ear (right hemisphere). Whereas earlier work had found that in general there is right ear preference for verbally presented material. Papuin, Kroshen and Tarbeck (1971) have presented an interesting development in the continuing investigation of lateralised hemispheric function. They ask :

"Is the left hemisphere specialised for speech, language or something else?"

They define the'something else' as the ability to make timing and order judgements, on the basis of their experiments which present certain sets of long and short tones in patterns, under dichotic listening conditions. Bearing in mind the key issue of 'ordering' in the dyslexic phenomenon their findings lead to more speculation. Could it be that the left hemisphere of man is primed for 'order' per se? That because language is spatially and temporally ordered phonological units, the left hemisphere is equipped to encode this type of input and organise the patterns to reality of external event? Could this be the true nature of the somewhat anthropomorphic L.A.D. of some psycholinguists? Future research could be directed to the pre-eminence of the left hemisphere for this type of function. These three

examples of current research are selected from all other possible work (e.g. Sperry, 1964; Zangwill, 1971; Semmes, 1968; Gazzaniga, 1965) to illustrate the experimental work in cortical laterality functioning.

Another confused area of research is that of measuring man's laterality. It is assumed in many experiments that man is conscious of his laterality and is thus able to give information about it. Bate (1974) investigates the whole field of laterality questionnaires and tests and questions the validity of their present form. Questions arise such as: Does the individual really use the hand he says he does? Is his memory accurate? Is a halo effect being produced, or stereotypic response bias being used?

Again, are some of the items used in questionnaires more important than others? Do certain items produce identical responses - how do we know that the best and most valid items have been selected from every day experience? From the writer's observational and clinical experience and from the findings of such authorities as Harris (1957) Annett (1970) and Oldfield (1971), the items in the Index were carefully selected to be as representative as possible and they were selected as performance items, not verbally reported responses. This area of laterality questionnaire illustrates the difference in level of current knowledge - comparing it for instance with the previous work mentioned on the dichotic listening experiments, or the clinical investigations of temporal lobe damage. The former is still at the level of assumption, whilst the latter findings are related to medical fact.

The third area of special interest is the neurological implications of laterality and in particular the concept of cerebral dominance. Bate defines some of the critical terms in present day use as follows:

Handedness: the preference of one hand or the superior skill of one hand for given activities. While a general definition is perhaps not possible, 'handedness' is taken to embrace all specific and general aspects of hand preference and skill.

Laterality: As defined by Touwen (1972), 'laterality' is the phenomenon by which ...."the performance of tasks, afferent or efferent, succeeds better on one side than the other". 'Laterality' is often taken to be synonymous with 'handedness' but includes also foot, eye and ear preferences.

Crossed laterality:
where preferences in at least two different modalities are contralateral (on opposite sides). This term normally applies to eye and hand preferences but again could apply to any modalities.

Mixed laterality:
refers to lack of strong preference or, inconsistency of preference in one or more modalities. It is often used to denote combinations of right and left answers of handedness questionnaires (as opposed to 'ambidexterity' which may involve equal skill with both hands on a number of items).

Cerebral dominance (sometimes 'Brainedness'):
refers to the greater involvement of one cerebral hemisphere in a particular function. Normally (and here) 'Cerebral Dominance', used without further qualification, implies the attribution of greater involvement in language function to one hemisphere (normally the left).

Equipotentiality:
the equal possibility of either hemisphere playing the greater role in processing of language stimuli. This term is often used in the context of lack of cerebral dominance at birth, but is taken here to involve lack of dominance at any age.

These definitions appear to the writer to clarify the issues of laterality and dominance and to give operational validity to concepts which are central issues in the proposed aetiology of the dyslexic syndrome. They appear to link also with theoretical and clinical findings on the nature of language and on the patterns of neurological functioning in "two-brained man" On this basis, the writer present an interface table of probable linkage between written language, skills to be acquired by the young child and the Index itself. (Table 12).

TABLE 13 THE INTERACTION BETWEEN CHILD AND WRITTEN SYSTEMS

Written language	" INTERFACE " Skills required in child of 5 yrs	Attempted assessment by Index.
Primacy of spoken language	Level of language usage	Vocabulary scale Picture recognition
Alphabetic system	Conceptual framework for a 'symbol' Perception of unit speech sounds and symbols used for these	Mental age measures - Draw-a-man, copying designs Phoneme/grapheme correspondence Sound discrimination
Word patterns (sequence of of phoneme contrasts)	Perception and retention of sounds in order	Auditory sequential memory
Spelling patterns (sequence of grapheme contrasts)	Perception and retention of ordered symbols	Visual sequential memory (symbolic
Ordered nature of language	Phonemes produced in correct order Awareness of ordered events	Sound blending Reproduction of common sequences (days of week, months of year)
Directional nature of symbols	Perception and retention of directionality	Visual sequential memory (pictoria Knowledge of left and right
Practical execution of written language	Motor control and directional fluency	Graphomotor test Copying designs
Total arbitrary, ordered, sequential directional symbolic system	Sensory and motor mechanisms able to integrate these events hypothesised as being more efficient when related to unilateral brain function	Laterality of eye, hand, ear, foot

In practical, every day terms, the task of diagnosing a dyslexic-type learning pattern in the classroom is in its very first stages, especially in this country. Indeed the very existence of a primary developmental barrier which involves perceptual mechanisms and laterality organisation is still denied by some advisers and psychologists. The very ordinariness of the young child's apparent level of learning potential militates against the understanding of this constitutionally based individual difference in acquiring skills. Slow-learning children, blind, deaf and cerebral-palsied children all have their outward 'stigmata', as do the physically handicapped children. Consequently enormous investment has been made in educational policy-making on their behalf. It is hoped that the Index will be one means of alerting both advisers and teachers to the plight of these other children whose modes of thinking although able and effective in some representational forms of environment and experience (e.g. visuo and spatial) fail in this one vital symbolic mode which represents the arbitrary system demanded by society in its search for universal literacy.

7.3 FINAL WORD

The implications of this study would appear to the writer to go far beyond the clinical diagnosis of a specific learning difficulty. They reach out to a fundamental issue of educational policy. Since 1870 there has been a statutory demand that all children, upon attaining the age of five years, should enter upon a course of formal education. The prime basic skills upon which rests all future learning are those of reading, writing and spelling; the power to express in permanent graphic form the transmitted culture of a society. The onus, therefore, is on society to make it possible for all its citizens to acquire these skills. It would appear that common assumptions, economic expediency, temporary fashions in education method, half-considered sociological dctrine or well-meaning idealism have all intervened between the young learner with all his own individual patterns and the very nature of the skill he must acquire. One returns again to the large groups of young children in beginner classes

to the teachers of these first critical stages, often ill-prepared in the techniques needed to begin the task; the total emphasis in some schools on "open plan and integrated day" whatever the realities, rules and regulations of the system to be taught or the pre-school socio-cultural preparations of the children.

Then there are the political fallacies which muddle egalitarian dogma on the one hand with the internal rule-structures of skill-acquisition on the other; "Why should I teach a child the rules of a society system I do not uphold?"

The ensuing confusion can be seen and heard when teachers who desire nothing other than to teach with skill, professionalism and effective method, meet to discuss the fundamental settings in which they work.

If only the emphasis first in training and secondly in practice could be on the fundamentals of learning! The writer has attempted to define some these in Chapter 3 of the theses - the well-prepared and educated teacher, equipped with knowledge of child development; knowledge of written-language structure itself and of the strategies and means of transmitting the necessary skills to all the differing levels of 'readiness' entering upon the formal business of education. This implies a small, secure group of children meeting initially to begin the formal learning process.

If only we could begin our educational system again, after vigorously thinking and planning the route to 'universal literacy', in the light of even present day awareness of all these events.

The parents of the boy whose case-history began the thesis were seen by a young educational psychologist. He made his diagnosis of the boy's difficulties on the basis of a degree in experimental psychology upon leaving school, two years' teaching in a school for partially sighted children, a year studying for a post-graduate diploma in educational psychology based upon traditional, environmental factors of failure and a few months clinical practice. After telling the mother that she was over-anxious and probably needed some treatment herself and to leave the boy to develop, he concluded "Dyslexia, mother, there ain't no such animal."

Perhaps in ten years' time, if we can begin to help children appropriately at the very beginning of education, in full awareness of intrinsic perceptual developmentals, we will be supporting his confident assertion.

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A P P E N D I X 1

INTRODUCTION TO ELECTRO-ENCEPHALOGRAPHY

(E E G)

14. INTRODUCTION TO ELECTROENCEPHALOGRAPHY

Mundy Castle * (1953) writes: "Electroencephalography is a method of recording electrical activity of the brain. This activity is like any other type of physiological activity: it is a manifestation of physicochemical disturbances in cells and in cells organised into tissues. Electrical changes are accompanied by chemical, thermal and mechanical changes, but the electrical are easiest to measure since they readily pass through tissue barriers and are apparent at a distance: furthermore, electronic techniques are far ahead of any other in dealing with minute changes".

The first report of electrical fluctuations from animal brains came from Caton (1875) who observed them in monkeys and rabbits and was convinced they were related to brain function. In 1890 (Beck, Von Marxon) and in 1893 (Von Marxow) there were reports of localisation of cortical areas by means of electrical potential changes following sensory stimulation, together with observations of continuous resting potential changes in brains of dogs and rabbits. In 1912 Kaufman not only confirmed the existence of spontaneous electrical potentials in the cortex, but showed that they could be recorded from the skull surface in mammals.

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* I am indebted to my tutor, Graham Harding, for allowing me access to the Ph.D. thesis of Mundy Castle, from which source much of this material is derived.

In 1913 Prawdicz-Neminski reported spontaneous waves arising from the motor and occipital cortix of the dog's brain, these having frequencies of 12 - 14 c/sec. and occasionally up to 35 c/sec.

In 1924 Berger began to study successfully the possibility of recording the electrical activity of the human brain through the unopened skull. He used a string galvanometer and checked the validity of his tracings by comparison with those obtained through trephine openings in the skull. He called the results "Elektrenkephalograms" or E.E.G.'s. His findings were confirmed in 1934 by Adrian and Matthews. By then it was accepted that the brain of man has an electrical beat arising from neurones and appearing as a mixture of more or less sinusoidal fluctuations ranging from 1 - 60 c/sec., being clearest at about 10 c/sec. in normal adults. Berger called this 10 c/sec. rhythm the "alpha" rhythm and activity at 15 - 60 c/sec., "beta" rhythm. He showed that the alpha rhythm changed with age, sensory stimulation and with various physicochemical changes in the body. In particular he noted that the alpha rhythm was greatest with the eyes closed and tended to disappear when they were opened.

Since Berger recorded on one channel from a pair of electrodes (Bi-polar) he believed that the alpha rhythm arises from the entire cortex. Later it was established that in fact there are several different rhythms arising from various parts of the brain. Adrian and Matthews (1934a and b) employed several fairly closely spaced electrodes and were able to show that the origin of the alpha rhythm is in the occipital lobe, near area 19 (Brodman's).

In reviews by Jasper (1937) Walter (1938) Gibbs and Gibbs (1941) and Lindsley (1944) descriptions and definitions of the various rhythms encountered during their work in the field of electroencephalography have been written. There follows a brief appraisal of the major electrical rhythms encountered in the normal human brain.

14.1 The Alpha Rhythm

The alpha rhythm can be described as quasi-sinusoidal electrical activity between 8 and 13 c/sec. inclusive arising from occipital or parieto-occipital and temporal areas of the head, normally being attenuated ("blocked") by visual stimulation and often by other types of sensory stimulation mental effort and attention. Bartley (1940) makes a distinction between alpha activity which he calls the natural period of discharge by the cells of the visual cortex and alpha rhythm which he defines as the synchronisation of alpha activity from many such neuronal units. Amplitudes of alpha rhythm range from 1 - 100 microvolts, whilst the duration of its presence, known as the alpha index and expressed as "per cent time", varies from 0 - 100 in different individuals. The most constant thing of the alpha rhythm is its frequency: it seems safe to say, after numerous investigations, that alpha frequency is fairly constant from month to month, and even year to year, periods in the same individual, variations rarely exceeding 2 c/sec. and usually being less than 1 c/sec. The alpha characteristics of an individual under experimental conditions may be said to show a high degree of diurnal consistency to the extent that it is possible to distinguish one individual from another by his brain potentials. Studies of twins have revealed certain unique features common to both members of a monozygotic pair, these being noticeable in the chief characteristics (notably frequency, per cent time, amplitude and responsiveness to stimulation) of the alpha rhythm. This has led to the conclusion that the E.E.G. reveals patterns of cerebral organisation with a

hereditary basis. (Davis: 1936).

Owing to the critical aspects of cerebral dominance in this study particular interest will be shown in the differences and similarities in symmetry and synchronisation of the alpha rhythm from the two hemispheres. Raney (1939) writes regarding his findings on laterality "the central excitatory and the peripheral nerve sensitivity of the dominant side of the cortex were greater than those of the non-dominant side since the alpha rhythm was less." (and conversely Grey Walter 1953 writes "the alpha rhythms ..... are most regular in their formation when the mental activity is least".). E.E.G. findings related to eye and hand dominance will be especially noted. It is relevant here to repeat the observations of Gooddy and Reinhold (1961). They stressed the hypothesis that in normal circumstances asymmetry of the functions of the two cerebral hemispheres is established as a child develops and that this asymmetry of function is closely related to the performance of reading and writing. Children with developmental dyslexia however fail to establish asymmetry of function in the cerebral hemispheres.

14.2 Other Characteristics of the alpha rhythm

"Blocking" x to eye opening is not true of whole population. The proportions are approximately 60% - "Blocking" alpha responses, 20% - no significant alpha rhythms found, 20% - persistent alpha activity. The three population groups are designated R (responsive), M (minus) and P (persistent) respectively by Grey Walter (1953).

There are several theories concerning the role of the alpha rhythm. These include:

(a) A "scanning" concept - Walter (1950) Craik (1943).
This concept holds that the alpha rhythm is a mechanism which continuously scans the visual projection areas (and possibly the association areas) in search of information. When the eyes are shut it sweeps back and forth across the featureless projection areas, but when they are opened it is broken up and desynchronised by the presented patterns, the extent and form of interruption providing a temporal version of the spatial display, this being dispatched to other areas of the brain in the form of frequency modulated action potential volleys.

(b) A mechanism of regulation - Darrow (1946).

This theory postulates that the E.E.G. is part of a mechanism of regulation which maintains varying degrees of equilibrium among four variables - alpha rhythm, cortical integrative activity, chemical condition and cerebral circulation, with the automatic nerves to the brain providing an important contributing influence. Darrow believes that the alpha rhythm itself depends upon impulses reaching the cortex over thalamo-cortical pathways, these impulses causing the cells of the cortex to beat in unison, the cortex returning impulses back to the thalamus thus setting up a feedback system. During cortical excitation the cortical cells take up their own individual rates of discharge, potential rhythms tend to cancel one another out and the alpha rhythm is replaced by low voltage fast activity or beta rhythm.

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x Attenuation. See E.E.G. Journal March, 1966 for most recent glossary

(c) "Synchronisation" theory - Adrian (1947)

Adrian suggests that the alpha rhythm is due to the synchronisation of large groups of cortical cells and originates in some widespread organisation probably involving the central cell masses as well as the cortex. He points out that there are abundant nervous connections for co-ordinating the beat and that when the rhythm is well developed it is possible to record impulse discharges in phase with it passing to and fro in the nerve fibres of the white matter below the cortex.

14.3 Beta Rhythm

Beta rhythm is broadly defined as activity between 14 - 30 c/sec. arising from any area of the brain but especially from pre-central, frontal and posterior during eyes open. Occasionally it is the dominant component in anxiety. In anxiety neurosis, it always dominates the record, as it does also after barbiturates when the effect is diffuse and through all channels. Normal cells are always driven into fast activity after barbiturates, but if cells are abnormal, they will not respond, therefore lesions can be thus located. Cohn (1946) has reported the occurrence of fast activity during hyperemotional states.

14.4 Theta Rhythm

This term includes all rhythms in the 4 - 7 c/sec. frequency bands. It is the dominant feature of the E.E.G.'s of children in the 2 - 5 year age group and is normal in children up to the age of 16 years. Theta rhythm can arise from any area of the head but particularly in the parieto-temporal areas. It may show variations during sensory and emotional stimulation also during mental activity particularly when this involves emotional changes.

Although theta activity is normal in children it would not be found to any great extent in normal adults. Abnormalities of theta activity are very common and vary greatly in degree. Theta activity in adults is often seen as a scattered, diffuse, bilateral abnormality in the frontal, temporal and central areas and this is an entirely non-specific finding often of little significance. More organised bilateral theta activity is common as an inter-seizure pattern in epilepsy, in psychopathy, in immaturity, in emotional disturbance or anger, or even with no clinical abnormality. In children there may be a greater preponderance of theta activity than one would expect for their age. All the above abnormalities are likely to be reported as "non-specific". Epilepsy, biochemical and systemic disorders, however, often give rise to bilateral theta activity.

Theta rhythm is also associated with the pre-menstrual phase, shortage of blood sugar, hunger, drowsiness and hyperventilation. This latter was one of the conditions of recording during the present research. The effect of over-breathing on the bi-temporal areas was noted, as was the recovery period. Theta abnormalities are the commonest to occur in adults and are the most difficult ot evaluate.

14.5 Delta Rhythm

This term was originally used by Walter (1937) to designate abnormal high voltage slow waves at 0.5 - 3.5 c/sec. found in the region of brain tumours. There is now a tendency for it to be used to describe all rhythms in this

frequency band. Delta rhythm as a normal constituent in the E.E.G. is found in infants up to the age of 2 years and during sleep in children and adults. In all these instances, voltages may range from 10 - 250 microvolts or more, whilst often the wave form is irregular due to the presence of several components. Other delta rhythms are abnormal and beyond the scope of this study.

14.6 Other Spontaneous Rhythms

1. Mu rhythm (Rhythme en arceau - Castaut 1952.) This rhythm is confined to the rolandic region. It possesses a frequency of 9±2 c/sec. and an amplitude of 20- 40 microvolts. It remains unaffected by eye-opening or mental arithmetic but is blocked by tactile and proprioceptive stimulation (first clenching) and by motor imagery. Investigation is proceeding into its incidence in the records of educationally sub-normal children. (Personal communication: Harding 1966).

2. "Lambda" waves - random mono-phasic positive potential changes which appear in the occipital and sometimes parietal and posterior temporal areas of certain people when the eyes are opened, most frequently associated with pattern vision.

3. The K complex and sleep spindle are both E.E.G. manifestations during sleep. The K complex is thought to be an arousal phenomenon originating in the reticular formation and alerting the cortex back to consciousness.

4. 2 and 3 c/sec. spike and wave discharges which are clinical abnormalities found in epileptic states of the brain.

14.7 Developmental Aspects of E.E.G.

1. Delta, theta and alpha frequencies are present in the youngest age groups.

2. Diffuse delta rhythm is often dominant until 1 year and persists as a sub-dominant component up to 5 - 6 years.

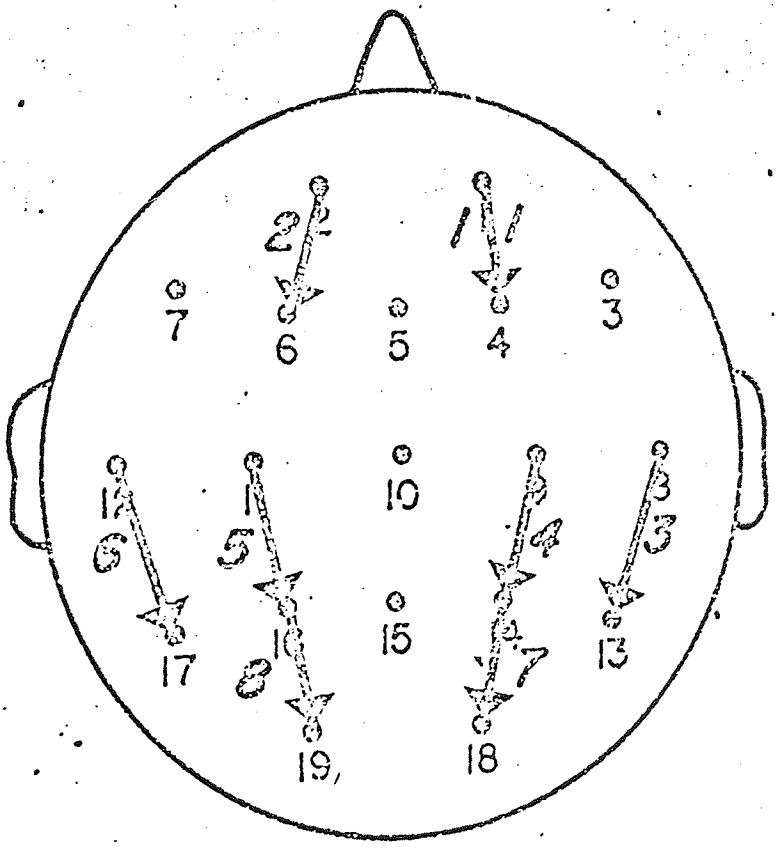
3. Parieto-temporal theta rhythm is dominant in the 2 - 5 year age group, is smaller in the 6 - 10 year age group, thereafter being very small or intermittent. Theta rhythm is usually augmented by closing the eyes and by emotion in children up to 2 - 3 years.

4. Analysis reveals alpha rhythm in the youngest age group. By the age of 5 - 6 years it is approximately equal in dominance to theta activity. It's frequency is 8 - 9 c/sec. in the older groups (8+ years).

5. The 10 - 10.5 c/sec. adult mean alpha frequency norm is reached by about 13 years, whilst the general features of the adult E.E.G. are fairly well established and consistent by 17 - 19 years.

When looking for absence or presence of abnormalities in the present study, it must be borne in mind that the age range is 8 - 13 years.

The following diagram shows the "montage" (placement of electrodes) used in one of the critical recordings. Special interest is in the occipito-temporoparietal areas of each hemisphere and a comparison of the records.



M.S. POSITION 7/9

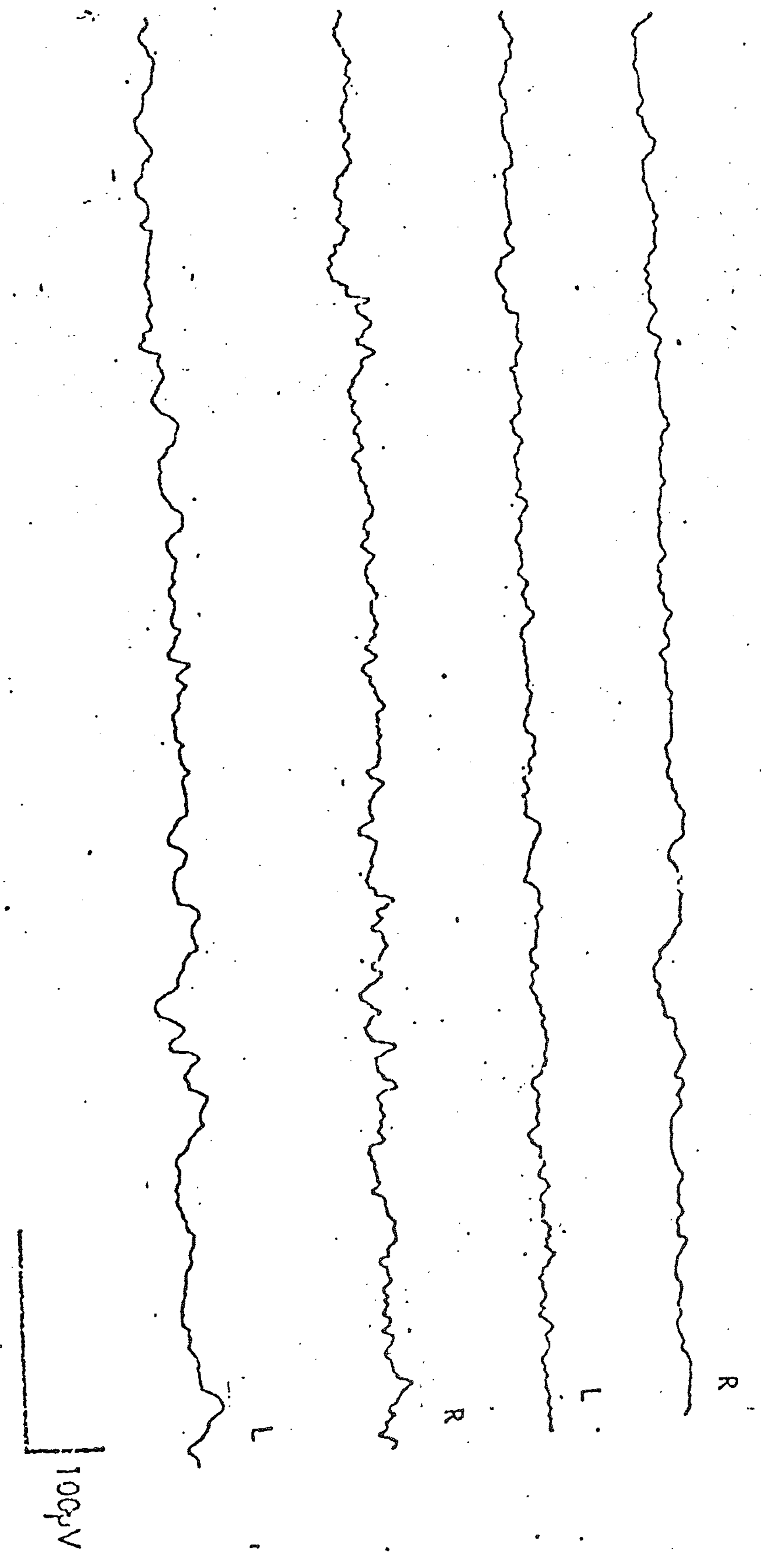
TAPE CH. 1. 3/7 2. 6/8 3. 4. G.

T.C. 0·3 F. 70 G.100

2 Recordings of 100" each; recorded on tape for automatic analysis.

The following records illustrate the symmetry and synchrony between the left and right hemispheres typical of the "dyslexic's" records.

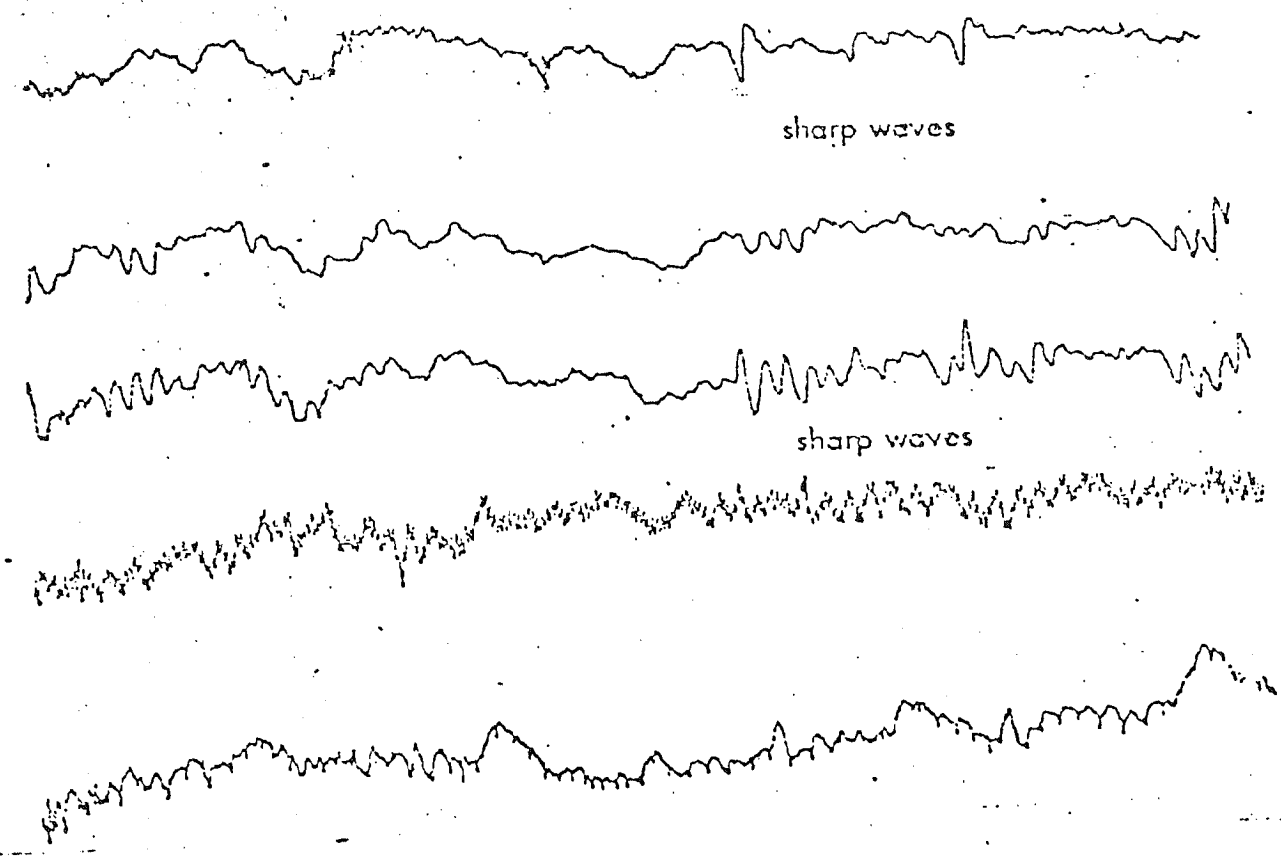
Subject number 10 Case



"There is scanty alpha rhythm which appears fairly symmetrical and synchronous. Mixed with the alpha rhythm is some 4 c/s and 6 c/s activity."

Case

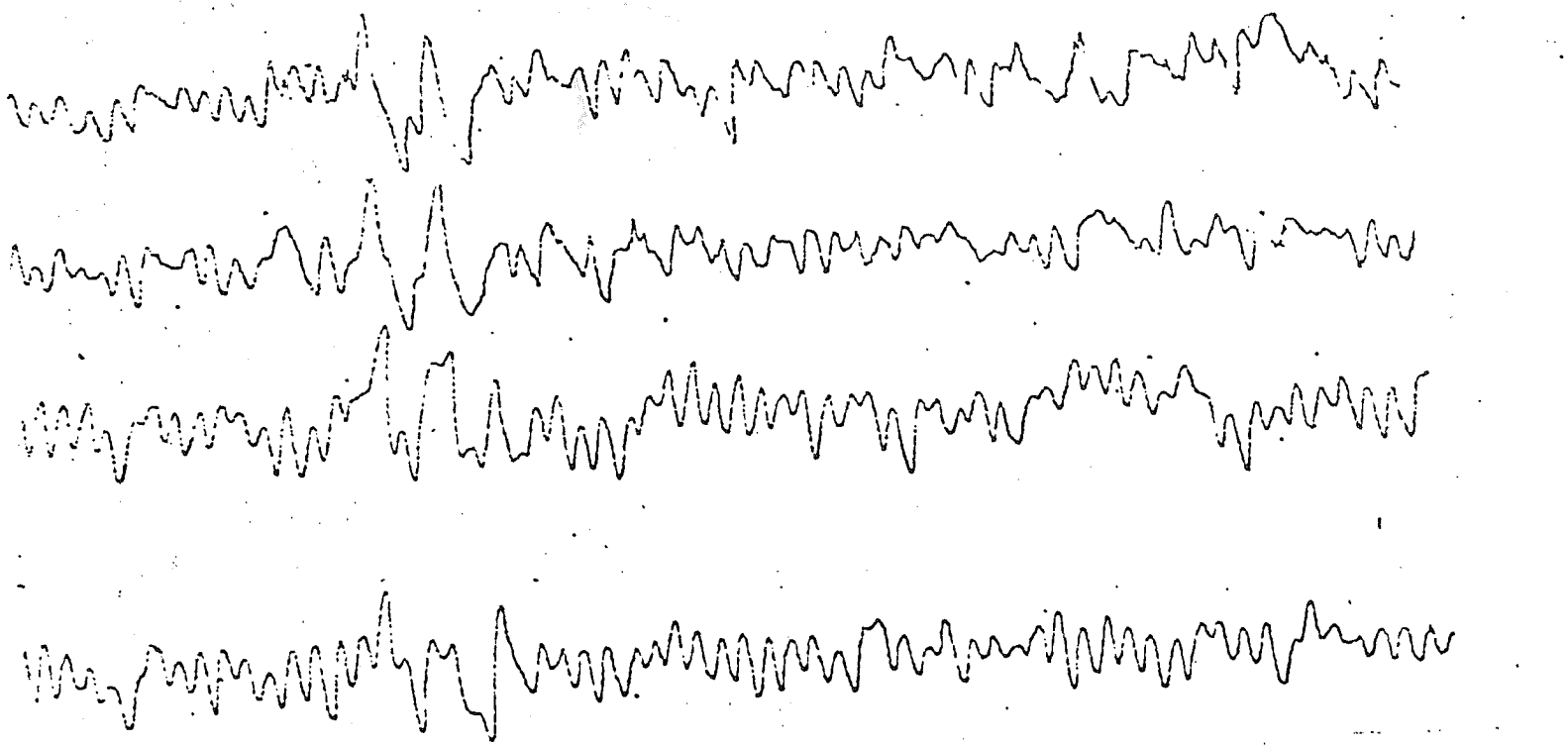
Subject number 22



"There are some sharp waves in the centro-parietal regions."

Subject number 16

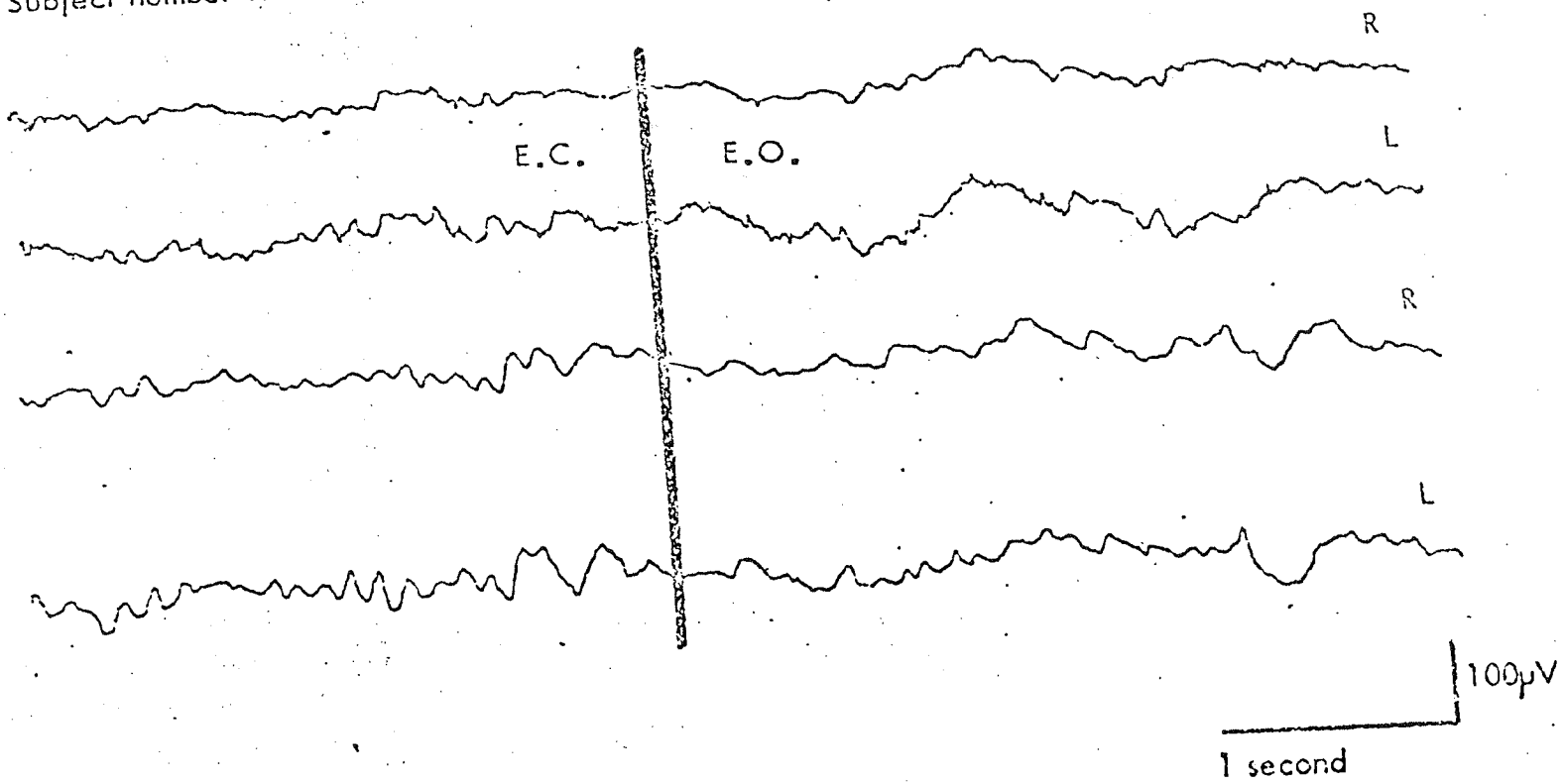
Case



"Overbreathing : Induces some 3 and 4 c/s activity, but the record rapidly returns to normal."

Case

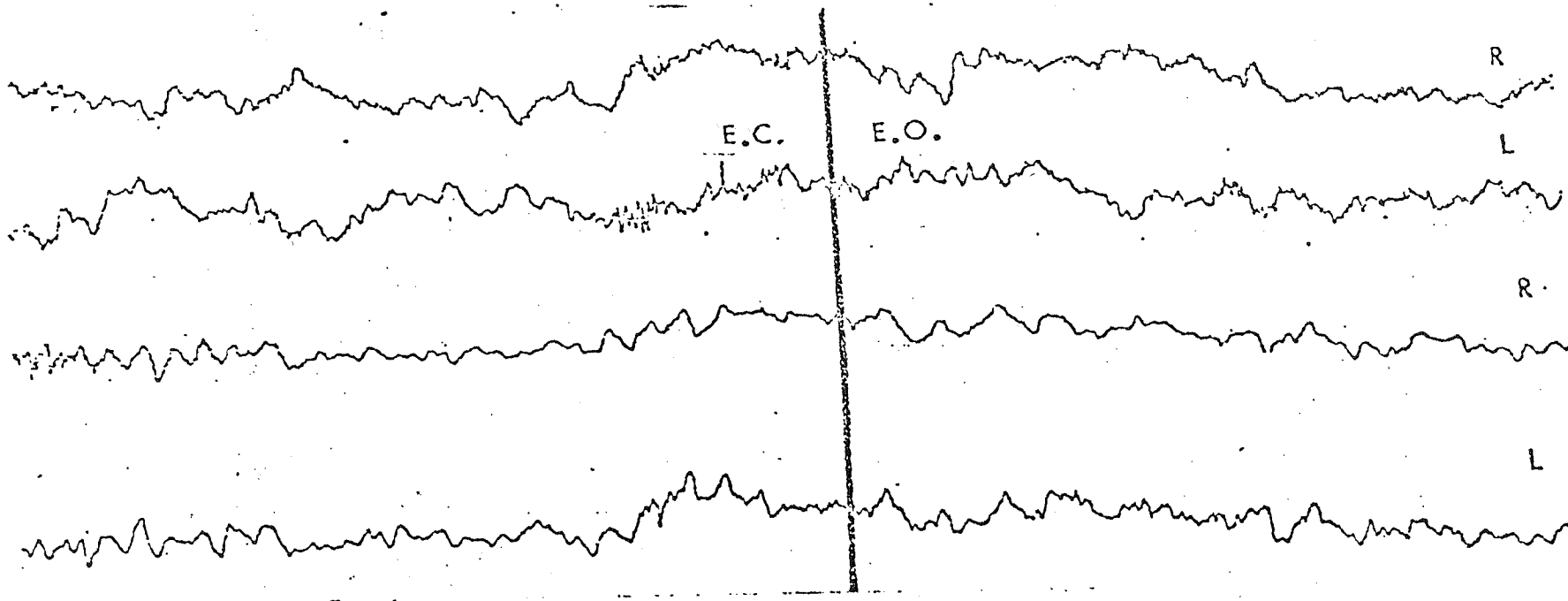
Subject number 17



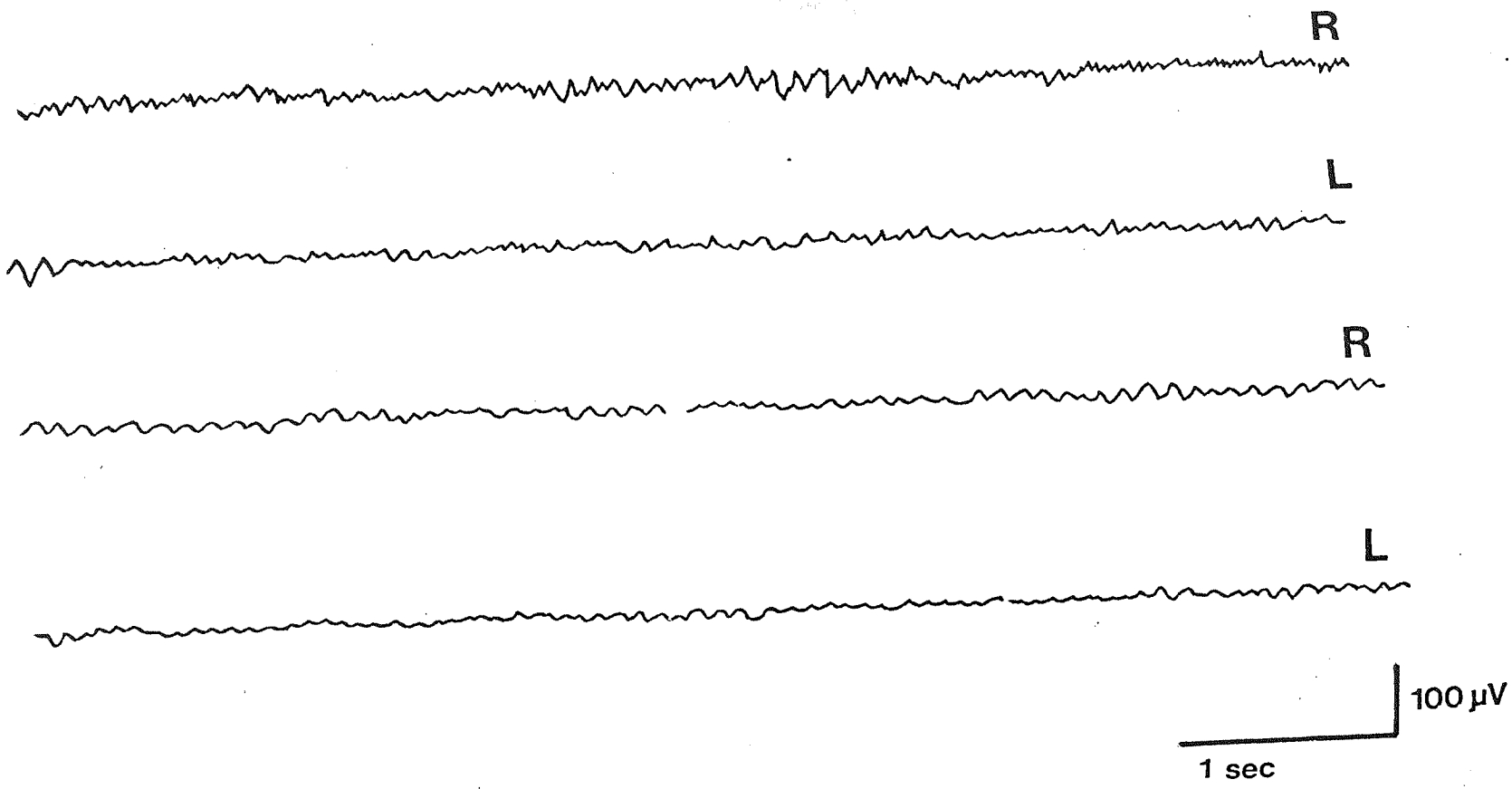
"Very little change occurs to eye opening; too immature and slow for age."

Subject number 19

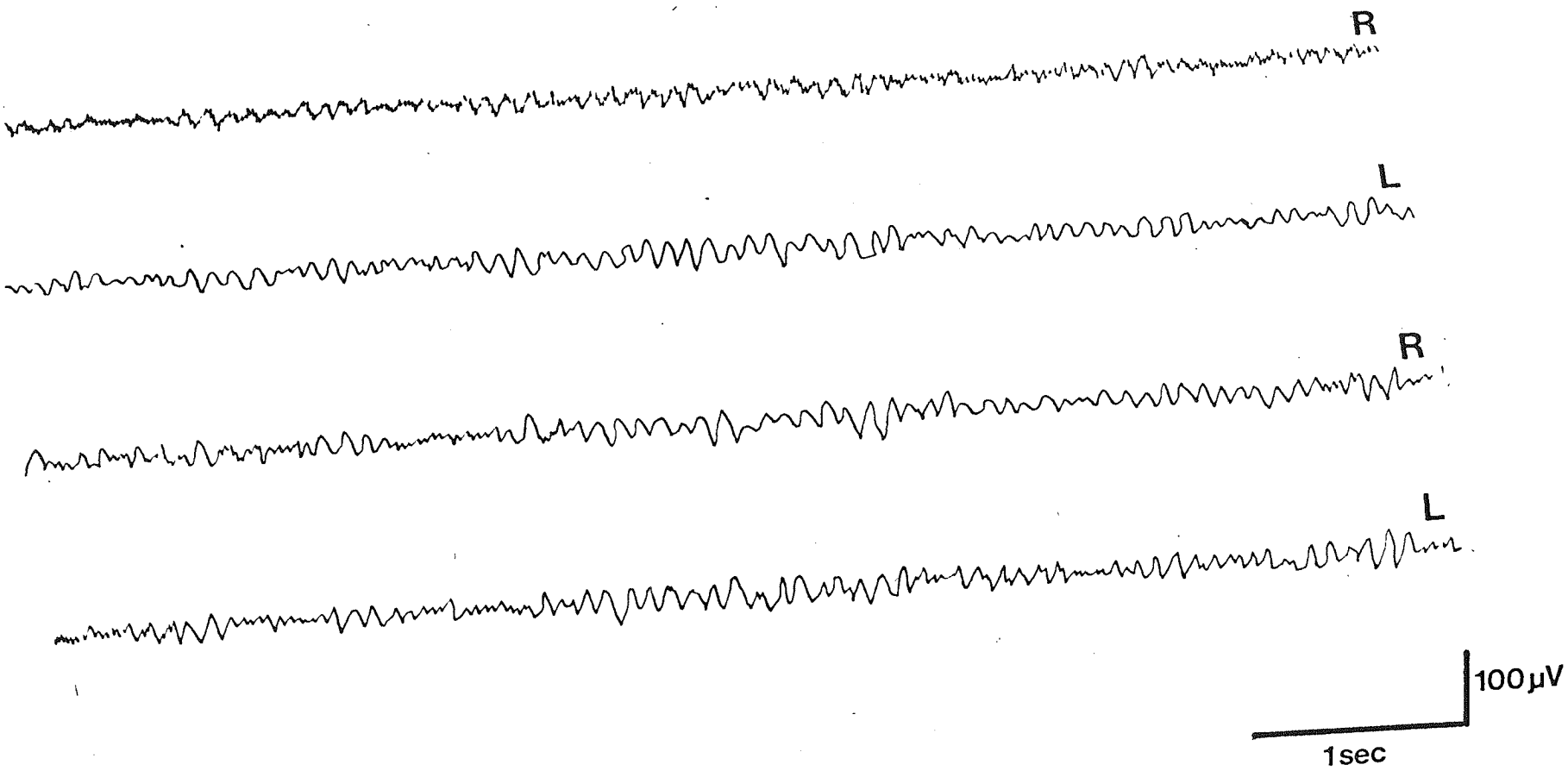
Case



"A mixture of theta activity with very little change occuring to eye-opening."



Asymmetry and asynchrony between right and left hemispheres in EEG recording of right-lateral linguist.



Symmetry and synchrony between right and left hemispheres, suggesting equivalence of underlying activity in the two hemispheres. From the record of an artist subject.