

AIMS OF THE MOTHER AND CHILD FOUNDATION



The Educator of Humanity: (Ashley Montagu: *The Humanization of Man*)

THE PRIME IMPORTANCE OF THE MOTHER:

Note the size of the child's hands compared to the mother's. Note the size of the child's head compared to the mother's. This picture shows us that the priority in human development is the brain. During early development the future health and abilities of the child depend on the mother.

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Aims of the Mother and Child Foundation

- 1. To prevent and relieve the sickness and disability and preserve and protect the health of pregnant women and their children.**

To date, the Mother & Child Foundation has funded studies on low birth weight, prematurity and adverse outcomes in pregnancy. The principle target has been to understand the cause and prevent disorders of brain development which sentence a child to a life time of disability, learning difficulties and behavioural pathology.

- 2. To advance the education of health professionals, the nursing profession and the general public, and particularly the parents of such children concerning low birth weight, its causes, and effects.**

The Foundation established the Mother & Baby Clinic in the East-end of London in 1994 with a generous donation from the late Dr Ann Gibson, Freeman of the City of London. It played an important role in defining the conditions associated with low birthweight and premature birth. It acted as a centre for the conduct of a randomised clinical trial which resulted in a better than 2 fold reduction in small for gestational age births. The Clinic is presently occupied by the Albion Kids Show it works with the children and parents together. The Foundation has organised several international conferences and joint-cooperative workshops. One of our trustees consulted for WHO and FAO on matters related to maternal nutrition and health, brain development and function.

- 3. To promote or assist in the promotion of research, prevention, alleviation and management of such ill health and disability and to publish the useful results of such research.**

From our research we have identified maternal nutrition and health even before pregnancy, as a key determinant of the health and development of the child..

Current research projects funded by the Mother & Child Foundation focus on maternal nutrition and health with the aim of enhancing maternal health, nutrition and happiness and at the same time arresting and reversing the present climb in mental ill-health amongst children. Mental ill-health has now overtaken all other burdens of ill-health at a cost in the UK of greater than heart disease and cancer combined.

The Foundation is managed by a Board of Trustees all of whom have experience in the field, It does not have its own premises. The work is voluntary – there is no paid staff. We have 12 voluntary supporters.

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Achievements

The work supported by the foundation and leading up to it has accomplished several breakthroughs of importance to the brain, mental and public health:-

1. Established docosahexaenoic acid (DHA) is essential for the brain. Confirmed by omega 3 deficient diet and behavioural pathology in a primate and cause of cerebellar pathology in chickens (i)
2. Established preformed, dietary DHA was an order of magnitude more efficient than the precursor for neurodevelopment. (ii)
3. Poor maternal nutrition is an independent risk factor for low birthweight and so for risk of learning disabilities, mental ill-health and other neurodevelopmental disorders. A study 533 pregnancies in Hackney, and 7 day weighed food intakes revealed:
 - Poor Nutrition and birthweight tracked up to but not above 3270g.
 - maternal nutrition was a risk factor independent of ethnicity, socio-economic status, and smoking. (poor = failure for 6 WHO RDAs)
4. Adverse nutrition of school girls with anaemia in puberty uncovered. (iv)
5. In a micronutrient RCT: In those who complied, confirmed biochemically, micronutrients reduced those born small for gestational age by 2.3 fold. (v)
6. Fatty acid status of the umbilical artery suggests it as a measure of risk in preterm infants to brain disorders. (vi)
7. Plasma fatty acids in preterm infants: a gross deficit of long-chain polyenoics required for vascular, immune and neural development.(vii).
8. Further evidence for the absolute requirement of DHA for the brain. (viii)
9. Red cell membrane oleic acid measured in in 296 pregnancies at recruitment predicted preterm birth at a better than 90% confidence level.
10. A DHA RCT (300mg) from recruitment, enhanced the growth (MRI) of specific regions of prenatal brain but only in the boys.(x).
11. Volumetric MRI analysis of girls revealed regional brain growth relationships with arachidonic acid not seen in the boys.(xi)/
12. A novel theory on the role of DHA in vision and brain function.(xii)

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Background

Mental ill-health:

Mental ill-health is now the foremost burden of ill-health and escalating. In the UK the cost was estimated at £113 billion in 2013, a cost greater than heart disease and cancer combined. The continued escalation of mental ill-health if left unchecked can only have one sombre end point. It is the greatest threat to the sustainability of humanity,¹

Attempts at treatment of the various guises of mental ill-health, in the elderly or children meet with mixed success. The reason is that the major set of brain cells divide before birth. The brain defends itself against change after formation by recycling its components. Disorders initiated prior to birth are irreparable. There is no catch up for stunted growth or development.

Although every effort needs to be made to help those affected, the logical way to address the global issue has to be to address maternal health and nutrition, even before conception. In this way it will be possible to cut the vicious cycle of what is a rising, multi-generational malady. Treating those who have a mental illness, important as it is, none the less is like shutting the stable door after the horse has bolted.

The biological priority of humans is the brain.

As the front-page picture illustrates the biological priority in human development is the brain. The mother is the person responsible for bringing the child into this world and hence her health and nutrition will be a pivotal factor in ensuring a healthy start to life with full health and abilities.

Sadly, too little is known about the nutritional requirements for the brain sixty percent of which is made of fat. Brain fat is made with specialised essential fats that you have to have in your diet. Then there is a collection of trace elements essential to its development and maintenance. What little is known is seldom applied.

Last century the nutritional paradigm was focussed on protein and body growth. This error happened because most nutritional research facilities were devoted to the interest of the animal industry and plant requirements. Protein for body growth is relevant to cows, pigs, chickens and horses.

On the other hand, human milk has the least amount of protein of any large mammal. By contrast to cows and horses milk it is a rich source of essential fats required for the infant and child's completion of brain growth and development. Happily most pregnancies have successful outcomes. However, if a baby is born too small and or very preterm, the function of the child's brain may be adversely affected for life. Damage or disorder during early development results in a lifelong disability.

Low birthweight, prematurity: causes of lifelong brain disorders

The Foundation has supported work aimed at understanding the cause of low birth weight and premature birth. Babies born preterm and at low birthweight, particularly those born small for their gestational age are at the highest risk of disorders of brain development.

INSERT PICTURE OF PRETERM INFANT FROM HOMERTON figure 1

Developmental disorders of the brain include disabilities of vision, hearing and learning, autism, epilepsy, ADHD and cerebral palsy.

All of these have a fundamental root in a prenatal disorder of brain development which results in a child sentenced to life time of physical and or mental limitations.

Cerebral palsy can have severe consequences and is in effect a stroke before birth. A stroke in adulthood has a nutritional component in its cause. It is similarly likely that a stroke before birth may have a nutritional background with an infection and subsequent inflammation as a either an independent or co-existing cause.

Tragically, the prevalence of low birthweight and preterm birth in the UK is unchanged since 1950, despite the wealth of advances in science and medicine. This is a shocking admission.

The Mother and Pregnancy.

The work supported by the Foundation has pinpointed the importance of maternal health and nutrition before and around the time of conception more so than during pregnancy. That is, the outcome of pregnancy is mainly decided before conception. Although this does not mean that good health and nutrition has no impact during pregnancy.

What it does mean is that the principle biological decisions regarding pregnancy outcome, whether the baby is born too early, too small or a bouncing healthy individual is in the province of maternal health and nutrition of the mother in the months running up to conception. Indeed, it also suggests that the health and nutrition of the girl during puberty when her reproductive system is getting its act together will also be of significance. This evidence makes common sense and has major public health implications.

A start needs to be made in schools

To defeat the rise in mental ill health and developmental disorders will require enhancing population health starting in schools when the physiological efficiency of the reproductive system is getting its act together in puberty. The health and nutrition of the mother is vitally important in deciding the future health and mental abilities of her child. The reason this is so absolute is that the bulk of brain cell division takes place early in the pregnancy and any distortion, stunting or disorder cannot be made good later in life. Damage at this early stage is irreparable.

The implantation of the fertilised egg happens on about the 7th day. It implants into the milieu intérieur of the mother. It is only logical that her milieu intérieur was not established over night but is the result of her recent history, nutrition, health and behaviour pattern.

Moreover, by the time the mother comes to the maternity unit for pregnancy care, some 12 weeks after conception the cells that will form the cortex of the brain are already migrating to do so. Events after that will not influence basic neurogenesis although they might impact connectivity.

What is the Challenge in Food Security?

Human nutrition: The focus on protein last century was flawed:

FIGURE TWO IMAGE OF BRAIN CELL

The priority of governments and the UN agencies in nutrition and food production has been and still is focussed protein. This is fine for beef, milking cows, horses, and pigs where body growth is important. Not for humanity where the brain is the biological priority and makes us human.

The brain is made of fat and very special essential fats are needed. Human milk has the least protein of any large mammal but is a rich source of essential fats for the brain.

The brain evolved in the sea 500 million years ago using marine fats. What else could be used? It still uses the same and requires these fats for its development, growth and function.

The brain requires essential fats, and trace elements rather than protein

The most limiting fat for the brain is a fatty acid - docosahexaenoic acid or DHA. It is the principle acyl component of the signalling membranes of the photoreceptor for vision, the synapses and neurones at the basis of our learning, actions, feelings, cognition and dreams.

The brain also requires minerals that coexist with these fats in the marine food web. Critically important are iodine, selenium, zinc, copper and manganese. These metal atoms are employed in special enzymes in the brain which protect it against peroxidation.

Remember the brain is only 2% of your body weight but uses 20% of your energy. It is a very high-rate oxygen user and paradoxically, is built with molecules such as DHA and arachidonic acid which are highly susceptible to peroxidation. Protection is needed and Nicholas Bazan Director of the Neuroscience Center of Excellence, School of Medicine, LSU, New Orleans¹ discovered that an oxidation process in the brain, acting on DHA, produces its own oxidative defence system which he called Neuroprotectin D1.

Professor Ephraim Yavin, when head of neurobiology at the Weizmann Institute for Science in Israel, fed breeding rats a diet with and without the omega 3 fatty acids. The deficient diet in the mothers resulted in a restriction of migration of the cells during their journey to form the cortex of the brain².

FIGURE 3 PPT OF O3 DEFICIENCY AND NEURONAL MIGRATION

. The yellow dots in the picture above represent the neurones that have been generated in the fetal brain of a rat the mother of which had brain fat in her diet compared to the paucity in the brain of the fetus from a deficient mother. (Picture courtesy of Professor Ephraim Yavin, Weizmann Institute, Israel). We now have a fair idea of the reason for the extreme conservation of DHA during the evolution of visual and neural systems.^{3, 4, 5, 6, 7}

This extreme conservation has profound implications for human mental health.

Nature speaks out on the priority of fatty acids for human nutrition.

We can only touch on the mass of evidence published since the 1970s identifying the importance of DHA, arachidonic acid and various trace elements for the brain. The problem facing us is that no Government has prioritized the needs of the brain or even mentioned them in food production and nutrition policies. The name of the game is protein. Faced with this elementary error, it is little wonder that mental ill-health is not escalating globally. The work the Foundation has supported has laid the grounds for arresting and reversing this sinister threat to humanity.

Think about it: human milk composition has been adapted over millions of years. Whilst there is a degree it is influenced by maternal nutrition, There is however, a fundamental, universal composition. Human milk has the least protein compared to other large mammals. It is however rich in the essential fats needed to finish the principle period of brain development and growth and serve the immune system and the rapidly expanding vascular system.

Our physiology is adapted to wild foods: that is logical and sense..

Our genome is only 1.5% different from chimpanzees from whom we separated 5 to 7 million years ago. Hence it is logical that our physiology is adapted to wild foods. These are very different to what we eat to day.

Neither the brain specific fatty nutrients, DHA in particular, nor the essential trace elements needed by the brain feature in any contemporary food production system. The paradigm is based on protein and calories: i.e on the nutrient requirements for body growth and weight gain.

There are for example 2 billion people at risk to iodine deficiency disease, the most well known cause of mental retardation. As iodine and the brain specific fatty acids co-exist in the marine food web, this means the same number are deficient of DHA. Iodine deficiency is now re-appearing in western countries.

In recent time there has been a increasing focus on the production of land based foods. The nutrition that powered the expansion of our brain from *the 350g of a chimpanzee to the 1.45 K of Herto man* certainly would have had a balance of the best from the aquatic and land resources. We need a balance of land and sea food if we are to maintain our intelligence and behavioural sanctity.

- Firstly, we cannot get all the brain specific nutritional resources we need from the land. Further intensification as proposed, will make the situation worse.
- Secondly, there is not enough fish and sea foods to provide for an equable amount of brain specific nutrients for the present population and it is being adversely affected by ocean warming.

The population of the planet was 1 billion in 1804. It took 123 years to add a further billion. It was 3 billion in the 1950s and then 6 billion in 2000. It took ONLY 10 years to add another billion. In a few years' time it will be 8 billion then 9 billion. We need to restore that balance which brought us here with our large brain and intellect. The continued degradation leads to an unthinkable, inescapable conclusion.

The rising cost of brain disorders and mental ill-health

Mental ill-health and brain disorders are now the highest cost in the burden of ill-health. The cost to the UK is more than heart disease and cancer combined. The cost of brain disorders in the EU was estimated at €396 billion in 2004. When checked in 2010 it was €789 billion.

We drew attention to the UK Government of the EU 2004 cost through the interest of Lord Morris, the previous leader of the trade union but a resolute campaigner for the disabled. Following his questions in the Upper House, an assessment was carried out by Dr Jo Nurse of the D o H. She arrived at the sum cost of mental ill health at £77 billion in 2007. *In 2013 the cost to the UK was £113 billion.* The cost in the USA is likely to be close to \$1Tr.

Moreover the crisis is spreading. The Global Forum for Health estimates the top 3 burdens of ill-health worldwide are now heart disease, perinatal conditions (adverse pregnancy outcomes) and mental ill-health. All three conditions have a common ground in poor nutrition, maternal health and the food system.

The solution lies in changing the paradigm for nutrition to prioritise the brain which will mean addressing the food production system. It will also require recognition that a child's mental and indeed physical health will depend on the health and nutrition of the mother in the period before and around the time of conception. Much attention is rightly paid to the mental health of children. We now need to focus on the beginning of life with the health and nutrition of the mother, prior to and after conception with preconception care clinics to promote the message and deliver the care needed.

The Importance of the Mother.

Our history in prenatal brain growth and the needs of the mother.

To better understand these specific needs of the mother, we raised over £3 million to support research on maternal nutrition in China,^{8,9} S. Korea¹⁰, the Sudan^{11,12}, and Thailand, Vietnam^{13,14}. Work since 1990 has provided our colleagues and us with a perspective on poor maternal nutrition in the challenge of poverty and the rise in mental ill-health especially in children. In particular, it identified the supreme importance of the maternal nutrition and health prior to and around the time of conception and discovered a powerful predictor of preterm delivery allowing the identification of those at risk early in pregnancy or better, before conception and offering potential intervention¹⁵.

Note in the images below, the high complexity of the brain developed from 28 to term at 40 weeks. Although the cells form early, they must locate to specific regions and make connections with each other through dendrite formation and synaptogenesis. Docosahexaenoic acid (DHA – omega 3) has been shown to stimulate dendrite formation¹⁶. It is primarily available in fish and sea food, again supporting the importance of fish and sea food before and in pregnancy,, despite false warnings of the FDA about mercury in fish^{17,18}

Maternal Nutrition and low birth-weight

The Foundation has invested £3 million in delineating the relationship between maternal nutrition and low birth-weight. Another £6 million is needed to put into practice what we have learnt.

Low birth-weight and prematurity, especially being born small for gestational age is a well-known, high risk factor for prenatal brain damage or developmental disorder. The brain after all is the priority in the human species during prenatal development.

Recent studies at St Thomas's Hospital have identified punctate lesions seen by MRI of the new born brain to be occurring with surprising frequency. Previously though unharmed, it now seems they predict the development of post-natal, motor disorder.¹⁹ It is surprising and tragic that so little attention has been given to maternal nutrition and health and prenatal brain development. Some 70% of the adult number of brain cells arrive before birth. Any damage or stunting prenatally is irreparable later.

Successful intervention of a trial of nutrition and pregnancy

The studies in the East-end concluded that poor maternal nutrition was a risk factor for low birth-weight independent of smoking, socio-economic status and ethnicity^{20, 21, 22}.

The results steered us towards a randomised controlled trial (RCT) of targeted micronutrients for pregnancy from first booking. The supplement led to a greater than 2 fold reduction in the proportion of babies born small for gestational age²³..

This successful RCT was the culmination of the research programme funded by the MCF, and conducted by the IBCHN with collaborators firstly with Professor Kate Costeloe and Dr Alison Leaf, at the Homerton Hospital Special Care Baby Unit in the East-end of London. It was later extended to the Newham General Hospital²⁴ with Professor Ovrang Djahanbakhch director of obstetrics and gynaecology and Professor Keb Ghebremeskel and Dr Yeoju Min at the London Metropolitan University.

FIGURE 4 MRI OF BRAIN 24 WEEKS ETC

Although neurogenesis takes place rapidly in the early weeks after conception, form and complexity of connections as seen in the images above, develop later, especially during the brain growth thrust of the last trimester. Babies born preterm are born before the brain completes its development putting them at high risk to disorders (Images with thanks to Dr Enitan Ogundipe).

New research on lipid nutrition and brain development

Presently the research is being done at the Chelsea and Westminster Hospital Campus of Imperial College in collaboration with Professor Mark Johnson (Obstetrics), Dr Enitan Ogundipe (Neonatal neural development), Dr. Shu-ling Chuang (Biome - Bacteriology, Chelsea and Westminster Hospital), and Dr Yiqun Wang (Lipidomic analysis) with Magnetic Resonance Image (MRI) done by Professor David Edwards and Dr Nora Tusor at St Thomas's Hospital.

We also collaborate with several research groups internationally mentioned in the portrait gallery of the IBCHN (www.ibchn.org.uk). Recent papers have been written with Drs Leigh Broadhurst and Walter F Schmidt of the USDA, Beltsville, Dr Captain Joe Hibbeln retired from the NIH, USA. Dr. Stephen Cunnane of Sherbrooke, Quebec, Canada, Dr Tom Brenna of Austin, Texas. Professor Manahel Thabet, The Gifted Academy, Dubai, Dr. Izzeldin Hussein, Muscat, Oman, Dr Rachel Gow then of Kings' College and Dr Phil Spiller, retired from the FDA and concerned about the misleading advisory of the FDA USA on mercury in sea fish²⁵.

Maternal health and nutrition prior to and around the time of conception is of greater importance than during the pregnancy.

The lipid nutritional status of 300 pregnant mothers was quantified. In a subgroup, MRI of the brain of the baby, was taken shortly after birth. The volumetric analysis revealed that certain regions of the boy's brains developed into larger volumes in response to the maternal omega 3 and 6 supplement²⁶. The data is being further analysed to find out why there was no response in the girls who appear to have a different relationship with the essential fatty acids. Back in 1974 at the Nuffield Institute of Comparative Medicine, John Rivers and Michael Crawford published a paper in Nature showing that boys were far more sensitive to essential fatty acids (EFA) status before birth. With breeding mice given an EFA deficient or sufficient diet, a high proportion of the males died before birth whereas the girls were unaffected prenatally²⁷. This early data is relevant to the present study in which the boys but not the girls responded to the EFA supplement.

This study described the impact of the maternal status for the lipids required for brain growth, structure and function on brain development both good and stunted. The evidence now published defines the lipid nutrition relationships to the development of different regions of the brain responsible for cognition, connectivity and other functions¹⁴.

The prediction of maternal red cell membrane oleic acid at first booking for pregnancy care, predicted preterm birth at with an Receiver Operative Characteristic (ROC) of 0.926 (n=296, p<0.000) at 34 weeks. The ROC also independently predicted birthweight below 2,500g (ROC 0.724 n=240 p< 0.000).²⁸

A previous study by Wendy Doyle at the Homerton, in the East-end of London, attempted test the effect of a vegetable oil, energy supplement and maternal education. Neither had much influence and it was concluded that the habitual diet (i.e. the diet before conception) had a greater influence than intervention during the pregnancy²⁹. In retrospective, this early study provides support for the Chelsea and Westminster study and the oleic acid result.

This powerful predictor for preterm birth also describes neurodevelopmental status of the mother.

A rise or fall of membrane oleic acid is in response to maintain membrane unsaturation and liquidity. It will rise or fall in response to the low or high status for the membrane long chain, essential, polyunsaturated fatty acids. These are the fatty acid, membrane-specific substrates for the growth and function of the brain. Hence the oleic acid bio-marker is also identifying the risk for prenatal developmental disorders of the brain, which are irreparable and so have a lifelong impact.

The red cell has a lifespan of 120 days hence this powerful predictor is based on the integration of diet, behaviour, absorption efficiency, metabolomics and genomics which amalgamate to produce the final membrane composition. The status of the membrane

lipid is a determinant of membrane protein function. Both the membrane proteins and the individual membrane fatty acids provide ligands for nuclear and other receptors, hence cell function and so in the macro sense, health and well-being.

to date, points to the importance of maternal nutrition, health and lifestyle around the time of conception and before³⁰. These findings are somewhat similar to the folic acid story but in a broader sense both nutritionally and in terms of neurogenesis and brain development³¹.

The egg implants 7 days after fertilisation into the *milieu intérieur* of the mother. It is common sense that this condition of the mother will have been dependent on her nutrition and health not just on one day but built equilibrated with diet over weeks if not months prior to the implantation. That *milieu intérieur* will be the condition under which the process of embryogenesis, neurogenesis, placental and fetal growth will depend.

It is like the *parable of the seed* falling on stony soil compared to good soil. Nothing new in this concept but so important to the health and intelligence of the future child.

Neurogenesis follows rapidly during embryonic development and by the time the mother reports to the maternity unit to register for pregnancy care (usually 12+ weeks after conception), the cells that will form the cortex are already on their way to do so.

Hence interventions after first booking, are too late for the major thrust of neurogenesis and indeed much else. None the less, maternal nutrition and care during the pregnancy will still be crucial both for the continued development of those brain cells, organogenesis and indeed the mental health of the mother herself. Our study has evidence yet to be published of several measures of maternal mental health being related positively to her status for red cell membrane DHA.

The hope of preventing neuro-developmental disorders.

The implication from our study is that of poor learning, epilepsy, autism and ADHD spectrum disorders, visual and auditory defects are like spina bifida and anencephaly preventable.

The importance cannot be over emphasised in view of the escalation of such disorders and the rise in mental ill-health which is now no 1 burden in the cost to society. Because these disorders have their origin in influence on brain development and in some cases frank prenatal brain damage, the impact is life long and the emotional, social and financial costs to the children families and carers is disproportionately high.

The Foundation now needs £2 million to establish a long term follow up study to put this conclusion to the test with sufficiently large population of pregnancies. Our target is 20,000 over a 5 year period with follow up of the new-born to 3 years of age. This large number is feasible at Imperial College with its 5 teaching hospitals each with 5,000 pregnancies a year. Another £4 million is needed to disseminate the information and initiate a programme for maternal nutrition and health especially in the low to middle income populations. The solution to poverty is healthy, intelligent children with the brain capital to ensure social and economic progress. Without that low birthweights, preterm delivery and associated learning disabilities, behavioural pathologies and worse will sap

social and economic progress and feed the downward spiral which is now not just a feature of poor countries but affects the rich as well.

Sir Kenneth Stuart, one of our trustees and a previous medical adviser to the Commonwealth has called for a UN voice for the mother.

Iodine deficiency and the SUDAN – Globally, 2 billion are at risk.

Figure 6 Iodine deficiency in the Sudan

Iodine deficiency is the best-known cause of mental retardation. Iodine is richest in the marine food web. Hence it exists with other brain foods, especially DHA. 2 billion people are at risk to iodine deficiency today. They are also likely to be deficient of DHA. Deficiencies of both retard brain development and function.

But note however, because of the fundamental flaw in the recent food system, this problem of low birthweight, premature birth and disorders of the brain are common to all. Whilst there may be more frequent occurrences in the poorer sectors, the studies show that poor maternal nutrition¹ is a risk factor for low birthweight independent of smoking, socio-economic status, and ethnicity³². A poor person with a good diet will be just fine: a rich person with a bad diet will not.

The conventional approach to restorative feeding of the malnourished women and children does not include the essentials vital for the security of the brain. Having drawn to the attention of the WFP the importance of maternal nutrition and health as well as to the need for brain specific fats to secure the future of the child, we both recognise that there is a great deal of work to be done to address this gap.

Another RCT in the Sudan on the prevention of crises in Sickle Cell Disease, successfully showed that a fatty acid supplement could prevent 60% of events. These events involve the arrest of blood flow in small blood vessels. When these occur in the brain they are effectively mini-strokes. In children repeated events robs them of full intelligence³³.

It is proposed to conduct a further study with larger numbers in a second country to validate universality of the treatment. The financial requirement for this new study is £400,000 as there will be a need to establish and transfer of technology and knowledge.

The results of these studies could save much suffering and loss of brain function amongst thousands of affected children.

The SUDAN STUDY: The Prevention of Low Birthweight, Prematurity, Stunting and Disorders of Brain Development.

Following the successful RCT demonstrating the preventions of 60% of the painful veno-occlusive events in sickle cell disease³⁴, and studies on maternal nutrition and iodine deficiency previously mentioned, Dr Kot Nyuar studied the nutrition and milk of Sudanese

¹ Poor was defined as a failure to meet 6 of the WHO daily recommendations for pregnancy. Diet assessments were made by 7 day weighed food intakes, and biochemical assessment of key micronutrients.

mothers³⁵. His results described the lowest levels for human milk DHA we have ever seen in over 6,000 milk samples across the planet: a sample with 0.036% was recorded. The mean of over 2,000 samples from 9 different countries was 0.37%.

DHA is poorly available from land based contemporary foods. Iodine deficiency is largely a problem of inland populations where soils have been leached by millennia after millennia of rain. Michael Crawford, in 1990-93 in a consultation with the Department of Health in Indonesia, found 60% of inland school children to have palpable goitre. There were none in the fishing villages.

Iodine and DHA co-exist at their richest in food in the marine food web. Both iodine and DHA deficiency cause mental retardation. There is a strong probability that iodine deficiency is accompanied by a DHA deficiency.

It is very likely that a DHA deficiency co-exists with iodine deficiency

In collaboration with Dr Izzeldin Hussein of Oman and Dr Mustafa Elbashir of the Department of Medicine, University of Khartoum, Sudan, together with Professor Kamal Elhag, of the Department of Medicine and Professor Shahinaz Badri Department of Pathology of the School of Medicine, Ahfad University for Women, Omdurman, proposals were discussed with Mr Anis Haggar of the Haggar Foundation in collaboration with a group from Imperial College, with to stop prematurity, low birthweight and the associated mental and severe prenatal brain disorders such as cerebral palsy. At an approximate estimate the prevalence of cerebral palsy is 10-15 times higher than the UK. Discussions started in 2015 v but stalled due to lack of funds. However, in 2017 Anis Haggar approached Imperial College with the idea of joint research. A team was sent to Khartoum organised by Dr Simon Taylor-Robinson.

Professor Mark Johnson and Michael Crawford went on a preliminary visit which was followed by the team from Imperial to both the Khartoum Medical School and Ahfad University for Women, Omdurman. The following team had a wider brief than just the prevention of adverse pregnancy outcome including, mental stunting and prematurity. An account of the visit and its conclusions was published in the BMJ by Dr Esmita Charani³⁶ of Imperial's NIHR Health Protection Research Unit. Unfortunately, political unrest and the fall of the Government followed by covid-19 put a halt on any progress. With vaccination and the decline of the impact of covid-19 together with a new civilian government in the Sudan there is hope now that the hopes can be regenerated.

A note on making cerebral palsy past history..

The cost of the intervention trial to test the prevention of cerebral palsy and allied disorders is no more than the cost the Courts are awarding for one child born with serious cerebral palsy.

In the UK and US, severe central nervous system disorder such as cerebral palsy occurs in about 2 births per 1000 live births. However, the proportion rises as birthweight falls below 2,500g. Below 1,500g you might expect 200 per 1,000 with severe brain disorder.

There are roughly the same number of babies born with cerebral palsy at normal birthweights as in the low birthweight-preterm group. The point here is that the women are not immune entirely to the nutritional conditions which give rise to a heart attack or stroke. Cerebral palsy is effectively a stroke in the developing brain before birth. There can be bleeding in the brain through a rupture of a blood vessel and or a failure of blood flow – called ischemia – which kills a part of the brain or damage the connections irrecoverably.

It used to be thought that cerebral palsy was due mainly to obstetric mishap. Someone dropped the baby of the floor headfirst or deprived it of oxygen. However, work initiated by our sister foundation The Little Foundation under the paediatrician Dr. Martin Bax who was at Chelsea and Westminster Hospital in London, has found this not the case. Martin gathered a group of European wide neurologists armed with Magnetic Resonance Imaging facilities to study the brains of children with cerebral palsy. In so doing they were able to define when the lesion occurred. They were all *well before the time of birth* meaning that they could not in the majority of cases have been due to obstetric mishap³⁷. Indeed as Professor Paul Polani had studied cerebral palsy for many years looking for a genetic cause and found none, Martin and his colleagues were able to say that the cause has to be due to nutrition and or infection.

However cerebral palsy is the tip of an iceberg of other development disorders as we have mentioned above.

Although there is a greater prevalence in the lower socio-economic and poor groups, these disorders are common to all.

Biomedical science now having identified principle markers for neurodevelopment it should now be possible to make cerebral palsy and its allied neurodevelopmental disorders, past history as with folic acid and spina bifida.

FUTURE ASPIRATION

A future for our children and theirs: the scandal of low birthweight.

The trustees now wish to develop the principles of the Foundation to be applied to poverty and adverse pregnancy outcomes for both the mother and the child. One of our trustees Sir Kenneth Stuart a previous medical advisor to the Commonwealth has recently published 3 seminal papers to draw attention to poverty³⁸.

Breaking the cycle of deprivation requires prioritising maternal health and nutrition even before conception, preventing low birth weight and prematurity. It is a scandal that despite the advances in science and medicine, *low birthweight and prematurity in the UK is at the same prevalence if not higher than in 1950*. Mental ill health has been increasing. IQ has been falling.

Professor Michael Crawford another trustee published a statement on the crisis in nutrition and mental health³⁹. The summary is that poor learning ability, cognition together with behavioural pathology undermines the ability of an individual to achieve. On a population basis it cements poverty.

Josette Sheeran when CEO of the United Nations World Food Programme (WFP) said in her report to the Board in 2010 “*We know now that if children under two do not receive sufficient nutrition they will be sentenced to a lifetime of mental and physical limitations*”.

This is the first time the significance of the brain has been recognised at this level of political management and is truly welcomed. Whilst she was correct, the most important consideration is the nutrition and health of the mother as the brain is formed before birth.

Plan of Action

To enhance public health and especially that of young women, their mental health, and the health and intelligence of the children.

Sir Kenneth Stuart called for World Charter for Mothers.

During a conference in 1993 at the Royal Society of Medicine, London UK, to celebrate the launch of the Foundation, Dr Mark Belsey then Director of Maternal and Child Health at WHO, Geneva, said: "Everywhere the interest of the child are rightly served by, UNICEF, Save the Children Fund, the ubiquitous Institutes of Child Health and the many NGOs.

He paused and then said "*There is no voice for the mother*"

There are now several organisations supporting maternal health and the mother but still not remotely on the scale of the child. Yet attending to much of the adverse conditions of child physical and mental-ill health, important and crucial as it is, it is still closing the stable door after the horse has bolted. We need a World Charter for Mothers is not United Nations Organisation for Maternal Health (UNMH). MACEND

We first needed to know the reason for developmental disorders. The results of our work and a successful double blind clinical trial leaves little doubt about the pivotal importance of maternal nutrition before and around the time of conception. Nature does not leave important actions to the last minute. By contrast she prepares in advance.

With the new knowledge gained in nutrition and on the specific lipid requirements for the brain, the foundation is poised to make a major breakthrough in public health and specifically in the prevention of adverse pregnancy outcomes which include the costly neurodevelopmental disorders and their effects on maternal wellbeing and health.

Activities envisaged:

- Interact with stakeholders the aid community with regard to what is already known on behalf of maternal health and nutrition to protect her and enhance the health and ability of the unborn child.
- To create a World Charter for Motherhood.
- Develop the web page and presence in the social media .
- Organise a major conference on the global crisis in nutrition.
- Develop action programmes on the prevention of cerebral palsy, autism and on maternal well-being and mental health to prevent adverse outcomes at home and abroad.
- Address the rise in mental ill-health which is seen as the most urgent priority in the health-societal sectors.
- Raise funds for research on the cause and prevention of neurodevelopmental brain disorders, mental ill-health and its implications for food security. Three doctorate

students will be required to help maintain our position and knowledge in the front line of the science. The subjects would be the prevention of adverse pregnancy outcomes

- i. Abroad: Sudan, China and Nepal.
- ii. At home: preconception care = in collaboration with NHS teaching hospitals at Imperial College – our evidence points to the supreme importance of the health and nutrition of the mother prior to conception.
- iii. By application of the knowledge gained to preventions and treatment of neural-disorders in children.
- iv. In all cases magnetic resonance imaging of the brain would be used as an outcome measure. Although expensive it provides hard, objective data on regions of the brain affected.

This cluster of future aims will be a new direction for the Foundation e will need to replicate the £4 million previously raised to get where we are today. .

To make a difference, further our knowledge, educate, change attitudes and have an impact on maternal health and poverty at home and abroad the Foundation needs professional staff of four people:, Action director, Web master, Fund raiser and PA . It needs a core fund OF £250,000/ year to start with. The core staff will be expected to engage in the following::

Dissemination:

The usual route for dissemination of the work is the insistence of publication of funded work in the peer reviewed literature. To date workers supported by or associated with the Foundation have published 153 such papers. The Foundation has also sponsored conferences on topics ranging from the “Health of the Nation Depends on the Mother and Child (1993) to the celebration of docosahexaenoic acid (DHA) in the brain (2010) both at the Royal Society for Medicine)

In all 21 conferences have been sponsored or co-sponsored with various universities and like-minded societies and held at venues such as the RSM, Royal Society , The Institute of Physics, The Ministry for Fisheries, Muscat Oman, the McCarrison Society, Imperial College, the University of Bergen and Toronto.

A new conference is required to draw the crisis in brain nutrition and mental ill-health to the stakeholders and leaders of nations.

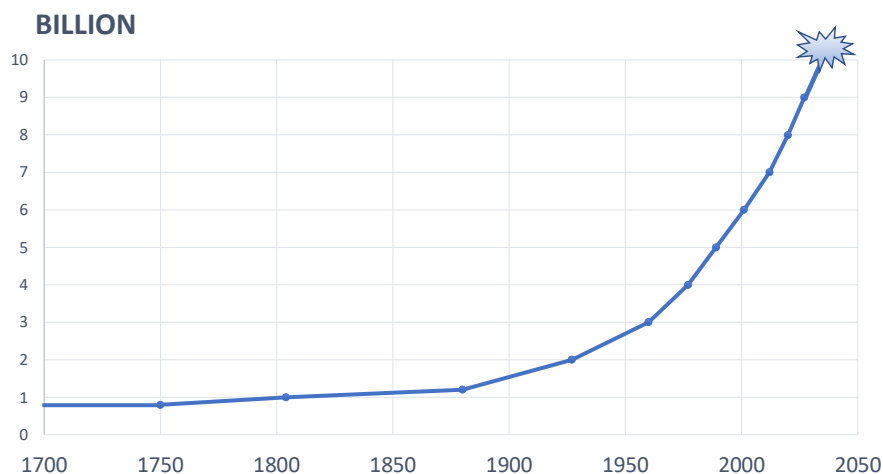
What if there is no action?

Brain disorders and mental ill-health already the no 1 burden of ill-health in the EU and USA and tragically being globalised. They are expected to continue to rise this century as heart disease did last. If this happens then the sustainability of humanity is threatened and the future outlook for our children is bleak. The converse of enhancing intelligence in future children to cope with the demands of this century is no longer an option. It leads to peace and prosperity.

THE POPULATION CRISIS

Population growth is now in its logarithmic phase which is unsustainable without action.

GLOBAL POPULATION GROWTH FROM THE 18TH TO THE 21ST CENTURY.



Population has entered a logarithmic phase of growth. On a planet of finite resources, continued population growth is unsustainable, To pretend that we can somehow accommodate ever-growing numbers, no matter how high they rise, is collective idiocy.

In 2011, The UK think tank Foresight, in *global future of food and agriculture*⁴⁰, claimed we had reached the limit of land available for arable use. The report was based on input from 400 experts across the world and was two years in preparation,

Farming the sea, or what some call mariculture is the only rational answer other than greening the desert instead of Mars (or at the same time). It helps solve the crisis in mental ill health and shrinking intelligence and also contributes to the battle against global warming and oceanic acidification.

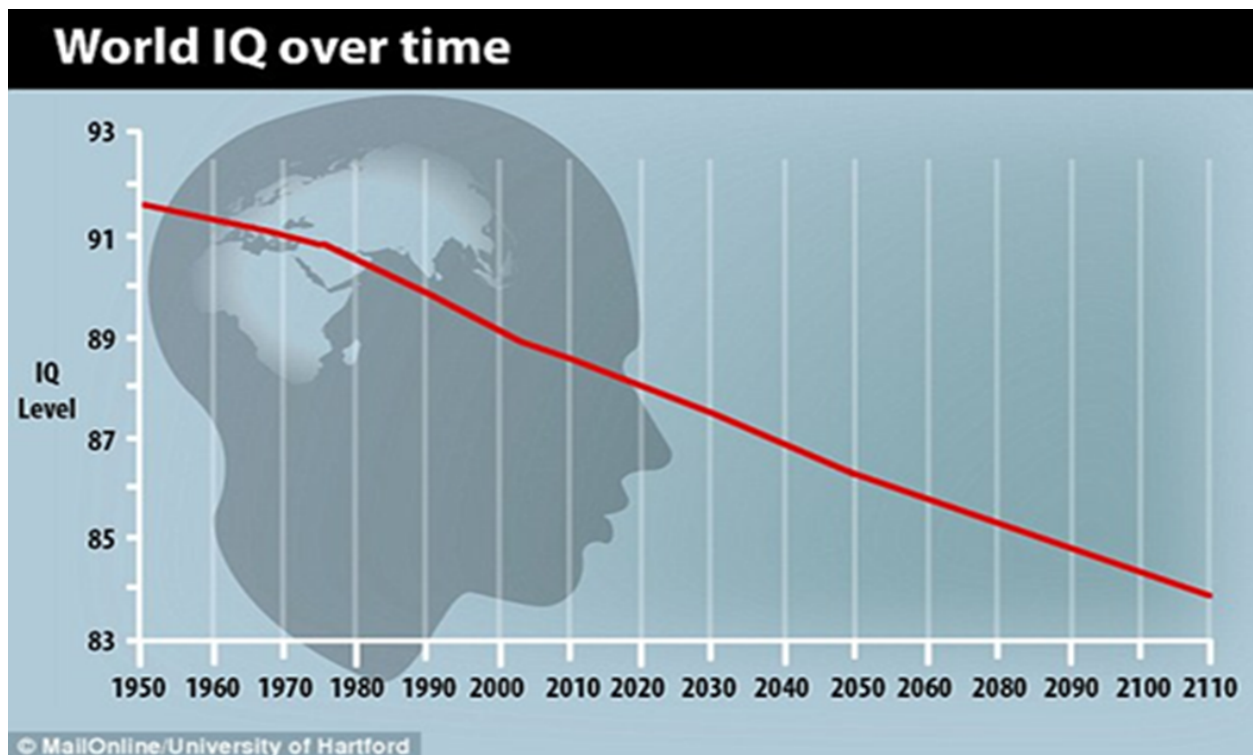
The shrinking intelligence

At the beginning of the 20th century, measurements of IQ increased over several decades. There is now deeply worrying evidence of a decline in IQ since 1950. Mental retardation is associated with a child with an IQ between 70 and 90. If the trend

continues, then by 2080 between a third and a half of the world's population will be borderline mentally retarded.

Quote from the new book by Michael Crawford and David Marsh (*The Brain Under Siege* – out September 2021)

“The rise in mental ill-health and shrinking intelligence is the greatest threat to the sustainability of humanity, ever. It is a graver threat to survival than global warming, as critical as that is. The two together unchecked, lead to the sixth extinction in the middle of the next century. It is Nature's way of testing her evolutionary products that come to dominance and then seeing to their end. The five main extinctions of the past have been environmentally triggered, one way or another. This coming one is rather unique: it is self-inflicted. It is a form of environmental destruction with no thought for the needs to support the very specific nutrition of the brain which made us human in the first place. It is a form of self-inflicted lobotomy.”



SOLUTIONS:

Globally, land for arable use is reaching or has reached its limit.

Prioritize the nutrition of the brain – the rest will follow.

Food production and security has been dependent on protein and calories. This does not serve the brain which is made with highly specialised fats. With the limits of agriculture being reached and the product of this system not serving brain health, one solution which is of outstanding importance for the brain is the agriculturalisation of the estuaries, coast lines and oceans. The total marine catch plateaued 20 years ago.

The brain evolved in the sea 500 million years ago using marine specific lipids. It still uses the same today⁴¹. Marine agriculture or what some call mariculture is a solution which will provide food and food for brain health. Marine aquaculture is already under strain from the lack of fish to feed the farmed fish.

No government prioritizes the nutrition of the brain in its food production and health. Where these exist, the priority is protein but as we point out and our evidences show, the brain is made of highly specialised fats with much not synthesised on the body and requires to be present in food, especially fish and sea foods of all kinds which provided for the origin of the brain in the first place.

Mariculture

The present estimated requirement just for DHA alone indicates that present marine and fresh water sources do not at present, provide the full requirements for brain nutrition equitably for all people. That alone implies we need to develop new sources of brain specific nutrients. Well we do not need to new sources because they are abundant in fresh water and marine systems. However, with the wild catch of fish reaching a plateau in 2000, the answer has to be to farm in the sea.

The precedent for marine agriculture (as opposed to aquaculture) is the development of land based domestication of plants and animals 10,000 years ago. China, Indonesia, Oman and Japan have already started marine agricultural development on a large scale. There are many small scale examples also sprouting up.

The Declaration of Manila 2012 sought to arrest and reverse marine pollution which is vital for a healthy marine wild catch and the development of marine agriculture.

The theme of EXPO 2012 in S. Korea echoed this position with:

“Life began in the oceans – we have to save the oceans to save ourselves”.

The brain evolved in the oceans 500 million years ago using marine nutrients as it still does today. It is now the turn of the oceans to feed humanity and help enhance cognitive ability to meet the challenges set by poverty and the rapidly expanding world population.

A new paradigm is also needed to enrich motherhood and change the priority in food production to serve the mother and brain on which the future of humanity depends.

Solving mental ill-health and helping counteract global warming.

10,000 years ago when land food resources obtained by hunting and gathering became scarce, people domesticated plants and animals. The present use of the oceanic resources is by hunting and gathering – a pre-historic method of getting food.

Figure 6 world capture fisheries plateaus 2000.

We have to do what people did 10,000 years ago with the oceans – its estuaries, coastal plains, white and blue water regions.

Kelp: we cannot grow any more rain forests on land, but can in the sea,

Kelp forests provide fertiliser for land based agriculture, trace element and iodine rich food for humans and sequesters CO₂ like rain forests.

In 1993 the results of a survey in Indonesia explained the poor school ability of many of their children, Some 60% had palpable goitre. Professor Crawford recommended farming kelp. The image below if the individual kelp plot under the surface of the sea appeared in National Geographic, March, 2001, pages 26-27. The kelp farmers are now making more money than the inland farmers.

Figure 7 Kelp farming in Indonesia.

A Japanese example of mariculture (marine agriculture):

In 1990 in response to a request from the Japanese Government Professor Crawford recommended farming in the sea. The concern was the effect on health and intelligence due to the limit to fish and sea food and Westernization of food.

They now have in the waters of the Shiraishi – Jima Islands, a marine ranching project with marine grass pastures, ecologically designed artificial reefs, and breeding centres for 7 target fish species, crustaceans and other sea foods.

This scheme is about ecological, sustainable development “*enhancing the whole eco-system not just fish*”. The result is a threefold increase in fish harvest compared to surrounding regions, which are in decline, and of course large-scale production of other sea foods (scallops, crabs etc) which long since had vanished.

Centuries of misuse tearing up the delicate seabed flora and fauna has created marine deserts. These can easily be restored. Creating marine pastures on the seabed provides for fish in the same way as grass pastures serve for cows and sheep. Pastures of *Zostera marina* on the seabed and kelp forests, shelter juvenile fish and fix CO₂⁴² helping to address ocean acidification and climate change. There is no fresh-water or artificial feed input required: the energy comes from the sun and the mineral wealth of sea water. By contrast, 500 to 750 litres of water is needed to produce one Kg of beef. Land based animal production and even vegetable crops are fresh water hungry. There is now such requirement when farming in the sea.

We need to agriculturalize the oceans as the Japanese are doing. Indeed the Chinese have been farming kelp for thousands of years and there are an increasing number of examples of

people successfully, developing the coastal water resources. Oman has 350 hectares of artificial reefs which two years from planting are already clothed with sea life much of which is photo-synthetic taking CO₂ out.

Marine Agriculture: Shiraishijima Island's Marine Ranching Project in Okayama, Japan

Takehiro Tanaka, Director of Fisheries Division, Department of Agriculture, Forest and Fisheries, Okayama Prefectural Government has been enhancing the ecology for seven target fish species. Shell fish production also adds to the equation. This is a sustainable system which requires no feed input benefiting from the restoration of the sea bed, artificial reefs tailored for the different species and the natural productivity of the marine flora and fauna.

Figure 7 Yokahama marine agriculture.

They have tripled productivity which has been declining in external seas. Dr Tanaka prefers to call it a ranching project.

There is hope but “we do not have time”

The late Professor Stephen Hawking said we have to leave the planet for a new world if humanity is to survive. He gave us 100 years. That was 2017, The clock is ticking and will not turn back. We have to act now with a global cooperative effort to sort the pollution of the lakes rivers and seas and mobilize our undoubted intelligence and academic expertise in human biology, marine and fresh water science. 71% of the planet is covered in water. Of the land only one third is available for arable use and that is being eroded by urbanization and population growth. The sea bed has been turned into deserts by floor trawling.

Vice Admiral Richard H. Carmona, M.D., M.P.H., F.A.C.S, the 17th Surgeon General of the United States, chaired a military science meeting organized with Dr Capt. Joseph Hibbeln in Washington in 2013 to discuss nutrition and mental ill-health as it affected the military.

Referring to the global issues discussed above he said in his concluding remarks

“We do not have time”

We still have the intelligence an ability to solve the crisis facing humanity. We just need to work together and do it.

.

Figure 8 Image of our world.

ABOUT US

Charity Registration No. 1037513

**The Mother & Child Foundation –
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Future Conference

Theme

We are planning a conference for 2023 on The Global Crisis in Nutrition. At present 2 billion people are at risk to a form of malnutrition that leads to poor mental development. The conference will deal with the population growth and the need for equable nourishment. It will draw attention to the Foresight report (2011) on the lack of arable land or new land to bring into agriculture in face of another 2.5 billion people by 2050. It will set the challenge that it is not just a cup of food that is needed but what is in the cup that matters. This concept

being promoted by UN-WFP is especially relevant to the needs for brain development and the challenge of the rise in mental ill-health.

PAST CONFERENCES:

1. Human Evolution - Past, Present and Future: Anthropological, Medical and Nutritional Considerations. Chair Sir David Attenborough May 2013.
2. A Celebration of DHA: Discovery, Achievement and Challenges for Global Health 40 years on. Royal Society of Medicine, LONDON, ENGLAND, 26-27 May 2010..
3. Two-day short course on "Intervention Strategies to Challenge the Rise in Mental Ill Health" [September 8-9, 2009]. London Metropolitan University..
4. Institute of Brain Chemistry [July 10, 2009] : Guest speakers - J T Brenna (Cornell University, Ithica, USA) & S. Cunnane(Research Center on Aging University of Shebrook, Quebec, Canada) <!--[endif]-->
5. Paediatric Nutrition Course- "The Role of Essential Fatty Acids in Paediatric Nutrition" [September 9-10, 2008]
6. International Conference on the Economic Importance of Fisheries and Their Impact on Public Health, Organised by Institute of Brain Chemistry and Human Nutrition/Ministry of Fisheries Wealth/Sultan Qaboos University/The Mother and Child Foundation, Muscat, Sultanate of Oman [8-10 March, 2008]
7. Expert Research Workshop on Omega 3 and Other Essential Nutrients in Neurodevelopmental and Psychiatric Disorders, A Meeting of Food and Behaviour Research in collaboration with the McCarrison Society, Mother and Baby Clinic, Science Centre, London Metropolitan University [March 27th, 2007].
8. The Letten McCarrison & Mother, Child Foundation Symposium [Oct 22nd - 23rd, 2006] * Neuroscience and Maternal Nutrition in HIV in Africa *: 22nd Oct - "Neuroscience" at the Novartis Foundation : 23rd Oct - "Maternal Nutrition in HIV in Africa" at the Royal Society
9. "Polyunsaturated Fatty Acids from Marine Sources: Effects of Health and Child Development", Centre National de Formation de Formateurs et D'Ingenierie de Formation, Tunisia [May 18th-20th, 2006]. Organised by Dr R E Lister, Trustee.
10. Generating Healthy Brains - Nutrients and Hormones in Development: mental health through coordinated care of life's beginnings, The Innholders Hall, 30 College Street, Dowgate Hill, London [17th January 2006]
11. Report on Dr Hibbeln's presentation in this meeting in Economist (19 January Edition) . Dr Hibbeln presented with the Cleave Award.
12. 4th World Congress of Cellular and Molecular Biology Association: Docosahexaenoic Acid - A Molecule with a 600 million year history in Neural Signalling, Cellular and Molecular Biology Association, Poitiers, France [7-12th October 2005]
13. The Letten – McCarrison Symposium on Brain Function and Dysfunction, The Royal Society, London [14th May 2004]
14. A McCarrison Society Conference: "The Elements of Health and Disease in the Soil", Institute of Physics, London [20th November 2003]
15. A McCarrison Society Conference: "Nutrition and School Children - Health Implications of the abandonment of Nutrition Education", The Medical Society of London, London [14th November 2002]
16. Caroline Walker Trust Lecture: by Professor Michael A Crawford, Chairman, McCarrison Society, The Royal Society, London [26th October 2002]
17. The Anne Gibson Memorial Lecture: Infant Nutrition a Peroxisomal Disease, University of North London [6th March 2002]
18. A McCarrison Society Conference: "Human Genome Project, Nutrition, Health and Food Policy", The Medical Society of London, London [19th September 2001]
19. A New Light on Human Origins, The Zoological Society Meeting Room - Regents Park, London [22nd September 2000]
20. Maternal Nutrition as the Key to the Health and Ability of the Child, Royal Society of Medicine, London [2nd December 1999]
21. Nutrition and Health of Children. A Global Responsibility. Medical Society of London, London [January 1996]
22. The Health of the Nation Depends on the Mother and Child, Royal Society of Medicine, London [November 1993]

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