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Origin of the Human Genome Project

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The latter part of the twentieth century and the early years of the twenty-first century saw unprecedented advances in biomedical research. The structure of the DNA double helix was discovered in 1953. Watson and Crick, 1953. About fifty years later, scientists in the Human Genome Project HGP finished genome sequencing, offering a comprehensive roadmap to the locations of the roughly 30,000 human genes an occasion lauded by special editions of the magazines Nature and Science. The decoding of the human genome is likely to go down as one of the most momentous breakthroughs in scientific history; nonetheless, it is evident that the genomic knowledge has not resulted in solutions to the numerous concerns regarding the hereditary basis of illness. The genome sequence may be considered as a dictionary, providing researchers with the foundation required to fill out the grammar and syntax of disease language. When the project was nearing completion, National Human Genome Research Institute director Francis Collins 2001 stated, the end of the beginning. the true payoff from the HGP will be the ability to diagnose, treat, and prevent disease, and most of those benefits to humanity still lie ahead. The genome sequencing data will be utilised to learn about individual human genetic variants. The quantity of genetic variation, or polymorphism, between humans remains unclear, as is the amount of variation gained as we age [1], [2].

Genetic Variation

While understanding illness requires a whole human genome sequencing, it is the characterization of genetic differences across people or groups that will give the most relevant knowledge. Phenotypes are caused by variations in genes or sets of linked genes. Physical characteristics such as hair colour, behavioral characteristics such as anxiety, and distinct physiological susceptibilities or reactions to gene-environment interactions are examples of phenotypes. Our aggregate individual phenotypes shape who we are, influencing whether we are at a higher risk of getting an illness than the regular populace or if a certain treatment would work, be ineffective, or even be poisonous to us. Individual genetic diversity is generally caused by single nucleotide polymorphisms SNPs and insertions and deletions of DNA known as indels. Discovering and describing these DNA sequence variants, as well as how they determine or impact phenotypes, is the subject of most contemporary research, and it is the beginning point for gaining a practical knowledge of gene-environment interactions and their many implications on human health.

Genetic Variability and Susceptibility to Lead Toxicity

Lead has long been known to be very harmful to humans. Although lead levels in the environment have been greatly reduced in recent decades, owing in large part to its removal from petrol and paint, lead toxicity remains a major public health issue, particularly in children who live in housing with lead-based paint residues or in lead-contaminated areas, such as areas near smelters or battery factories. The issue is complicated by the fact that lead persists in the body and that lead gained early in life may be released into the circulation to cause physiological havoc later in life for example, during menopause.

Environmental health researchers have discovered that polymorphisms in certain genes might make some people significantly more vulnerable to the harmful consequences of lead poisoning by changing the

toxins absorption, accumulation, and transport. Variants of the gene coding for -aminolevulinic acid dehydratase ALAD, an enzyme involved in heme biosynthesis, seem to have a negative effect on lead levels in bone and blood. Polymorphisms in the vitamin D receptor VDR gene have been linked to increased lead accumulation in bone. Variants of the hemochromatosis gene, which codes for the HFE protein, which is involved in iron transport in the body, may also have an impact on lead absorption and transport. The identification and characterization of these and other genetic indicators of greater vulnerability to lead toxicity are critical scientific milestones in the endeavor to minimize, treat, or prevent gene-environment interactions that cause illness and dysfunction in lead poisoning patients [3]–[5].

Ego Cases

The EGP has already generated extensive knowledge regarding genes involved in gene-environment interactions at the core of human illness using the candidate gene method. EGP scientists Clement Furlong and colleagues have done thorough examinations of polymorphisms in the paraoxanase gene PON1 Davies and others, 1996; Jarvik and others, 2003; Li and others, 2000. The gene controls the synthesis of the enzyme paraoxanase PON1, which metabolises hazardous organophosphates as well as certain medicinal compounds like cholesterol-lowering statin medications. Furlongs team revealed that some SNPs affect PON1 activity, affecting enzyme synthesis. Their research convincingly established that an individuals PON1 status affects vulnerability to environmental illnesses such as organophosphate poisoning and cardiovascular disease. PON1 status is also thought to have a role in vulnerability to Gulf War condition as well as Parkinsons disease, while research on the subject have shown mixed findings.

Martyn Smith of the University of California, Berkeley, investigated gene-environment interactions in blood-related diseases such as leukaemia, lymphoma, and myeloma. Many occurrences of leukaemia are considered to be caused by environmental factors such as benzene exposure, radiation, and chemotherapy drugs. Genetic variables are also expected to play an important role, particularly in the pathways that govern DNA repair and damage from oxidative stress. Smith and his colleagues discovered one potential gene that seems to be involved in the genesis of leukaemia: NADPH: quinone acceptor oxireductase 1. NOQ1. This enzyme helps to avoid oxidative damage caused by exogenous and endogenous quinines, which are physiologically active molecules present in vitamins, aloe, and henna, as well as chemicals like photographic fixatives and dyes. The C609T variation in that gene, which affects 5 to 20% of the population, causes full loss of enzyme function.

homozygotes those having two copies of the variant gene people with two copies of the variant gene. Case-control studies show that the 609T variation is associated with a 1.5- to 2.5-fold higher odds ratio for numerous kinds of leukaemia While this impact is minor, bad environmental exposure may combine with this genetic mutation to greatly raise illness risk [4], [6], [7]. The notion of environmentally responsive genes, and the genes chosen for research by the EGP tend to fall into eight categories: cell cycle, DNA repair, cell division, cell signalling, cell structure, cell proliferation, apoptosis, and metabolism. Cell cycle and cell growth genes control a cells capacity to proliferate, expand, and differentiate. Modifications in a cells development through the cell cycle, for example, might boost the cells capacity to tolerate stress by enabling cellular damage to be repaired prior to cell replication. All biological processes, including the growth and differentiation of cells, are affected by cell signalling and gene expression pathways. Metabolic pathways are critical predictors of exposure result. Innocuous chemicals may be metabolically transformed into reactive species that cause cellular harm; conversely, certain metabolic processes eliminate hazardous substances by modifying the chemical structure of the component.

DNA repair genes may impact the result of DNA damage caused by environmental factors. People with a stronger or lesser ability for DNA repair are at a reduced or higher risk of developing specific forms of environmentally caused illness, accordingly. Apoptosis, or necroptosis, occurs often in severely injured cells. This process protects the body by eliminating damaged or abnormal cells, and failure to carry it out is linked to negative health repercussions such as cancer. The EGP has sequenced over 400 candidate

genes, the majority of which are involved in metabolism, DNA repair, and cell cycle. Another milestone was the creation of the publicly accessible Gene SNPs database, which details hundreds of novel SNPs that have been made available for scholarly use

The EGP has also focused researchers' attention on the functional importance of polymorphisms, with the goal of determining whether or not each variant is an active component in exposure-related illness. One approach to linking SNPs and indels to function is to create and test animal analysis of human gene variations, which the EGP is now undertaking via a project called the Comparative Mouse Genomics Centers Collaboration. This projects mice models will be subjected to phenotypic analysis in susceptibility to extreme environmental testing.

Population-based research, in which large numbers of people are screened for variants and the data is analysed to determine associations between polymorphisms, disease susceptibility, and exposures, can shed light on the significance of individual polymorphisms beyond the laboratory. The effects of single gene polymorphisms are thought to be rather mild, and the disorders under investigation are thought to be polygenic, involving combinations of several genetic variations and exposures. Because of these considerations, population studies will need to be quite big in order to identify subgroups at elevated risk of illness because of their particular genotypes. This will surely be a difficult component of the EGP, but it is this sort of information that will have the greatest impact on public health.

Linking Genes and Environmental Exposures

The traditional approach to environmental exposure assessment has proven to be an extremely effective framework for environmental health research, working from the release of a toxicant into the overall environment to human exposure to internal dose to biological effect and, eventually, disease. Its component procedures have evolved, and new measurement and evaluation techniques are being created. Advanced methodologies are used in the hazard assessment approach to exposure to describe the link between the dosage of an agent and the unfavorable reaction of a model organism [7]–[9]. Clearly, the agent itself is the beginning point for this sort of inquiry, coupled with a number of questions: Is the agent poisonous? How harmful is it at certain levels of exposure What are the biological consequences of these exposures How do genotypes influence the magnitude of these effects? The ultimate challenge, of course, is how this data might be used to properly forecast human health effects after exposure to ecologically appropriate amounts. These may be exceedingly complex topics, however methods for characterising dose-response slopes at the molecular level such as transcriptional, protein expression, metabolism, and so on are developing.

This enabled the establishment of the conceptual model known as systems biology. The purpose of systems biology is to comprehend the overall functioning and reactions of the organism by combining information about its parts such as genes and proteins with knowledge about elements interrelationships. Several labs are using high-throughput technologies to acquire a better knowledge of how the system works while refining data on dose-response connections. To understand the links between disease and environmental exposures, several distinct categories of information must be pursued concurrently, such as the measurement of general atmospheric pollutants and toxicants, the fate and transport of hazardous agents in the ecosystem, the human body burden and metabolism of such agents, and exposure biomarkers. Yet, all of this data must be clearly linked to the illness burden.

This necessitates the development of a new exposure-disease strategy capable of providing reliable, consistent health status endpoints that can be assessed accurately over several years. The disease-oriented approach, which is currently emerging as a new concept in the field, begins with a clinical disease and the public health burden it represents as a starting point, or surrogate of exposure, and then facilitates investigation into the molecular characterization of disease and the underlying vulnerability responses This method is now being utilised to study gene-environment interactions in significant illnesses that are impacted by environmental exposures, such as breast cancer, Parkinsons disease, and autism. To identify subgroups at risk and groups of unaffected people for comparison, the disease-oriented strategy depends

on both exposure research and large-scale investigations of the general population's health state over lengthy periods of time. This technique will need large-scale and time-consuming research projects.

The -Omics Technologies

Many significant advances in environmental health sciences have been facilitated by the availability of a better scientific toolbox: improved cellular and animal models; new, more precise experiments, materials, and computational tools; and, perhaps most importantly, new scientific specialties known collectively as -omics technologies. While genetics has embraced genomics, several conventional specialties of biology have now adopted a -omics component, each capable of researching biological processes on the genome scale. For example, pharmacogenetics, which studies the response of individual genes to medicines, has evolved into pharmacogenomics, which examines drug response across the entire genome and is widely used to identify drug candidates, screen compounds for medicinal activity, and characterise response phenotypes.

Pharmacogenomics is a component of the movement towards customized medicine. While such an application of biomarkers is still on the horizon, the discipline is already having an influence on people's medical treatment. Trastuzumab Herceptin is offered in conjunction with a diagnostic that assesses if it will function in particular individuals; if a patient's tumor is discovered to be of a kind that will react to the medicine, therapy is started; if not, alternative therapies are used. Personalized response to medicine or lack of response or hyper response is undoubtedly a significant expression of gene-environment interaction. Yet, given the wide meaning of environment, there are several more.

The study of links between environmental exposures and genetics has given rise to the relatively young subject of toxicogenomic. Toxicogenomic has its origins in classical toxicology, but the capacity to concurrently evaluate or interrogate all of the genes in a genome enables researchers to use a systems biology approach to an organisms reaction to an environmental insult. Genome wide screens may give information on the pathways and signaling networks that are crucial to outcomes by documenting which gene expression occurs in response to a certain exposure. Because of the growing number of animal genomes that have been sequenced, such as mouse, rat, yeast, zebra fish, worm, and other genomes, researchers are also investigating comparative toxicogenomics. Comparing genomic responses to similar environmental exposures in animal species as well as humans is an effective tool for uncovering and explaining cellular pathways in the environmental response machinery.

Two more -omics fields should be discussed for the sake of this chapter's comprehensive review of genetics and environmental health proteomics and metabolomics also referred to as metabonomic and metabolic profiling. The study of the proteome, or the global expression of proteins in a cell, is known as proteomics. In contrast to the genome, which is more or less static, finite, and can be entirely mapped, the proteome is continually changing in reaction to the biological environment, and proteins interact with one another in a highly complicated manner. As a result, a cellular proteome is unlikely to be completely mapped since it is too dynamic and almost indefinitely changing. Yet, one goal of proteomics is to learn which proteins are produced by which genes, when and where in the cell, at what amount, and in response to what stimuli. When these concerns are addressed, protein-protein interactions are described, and hallmark patterns of response are formed, vast volumes of relevant knowledge are predicted to emerge from the area.

Proteomics also seeks to categories protein expression discrepancies between known samples, such as sick and no diseased or exposed vs unexposed. Disease-specific proteome patterns may be found without necessarily identifying the exact proteins implicated. This technique seems promise in the field of clinical diagnostics, with promising findings already shown in the early diagnosis of certain cancers and the capacity to forecast the metastatic destiny of lung tumor's. The goal of functional proteomics is to discover the functions of proteins and protein subsets by describing their interrelations and functional significance in signaling networks, disease mechanisms, and other biological processes. Structural proteomics is the study of the three-dimensional protein structure as they reside inside the cells

architecture. Such data may help to explain disease states and biological processes, as well as suggest to techniques for developing therapeutic drugs. Finally, toxic proteomics is a distinct discipline in which researchers use proteomics approaches to find cellular and subcellular processes underlying reactions to environmental toxins and other stresses at the protein level. To complete its tasks, each proteomics speciality employs extremely sophisticated bioinformatics.

Metabolomics is a phase in the process of going from illness to exposure, or vice versa. Enzymes control the synthesis of metabolites, which are often the biochemical endpoints of the response process. Metabolomics is the study of metabolites, or suites of metabolic pathways, in physiological fluids as they relate to specific reactions. These data may be used to generate fingerprints that can be used as biomarkers of response, with the identification of the chemicals themselves being a secondary factor. All of these -omics endeavors play a vital part in the overall plan to master systems biology and toxicology. As experimental technologies advance, as do the bioinformatics tools needed to extract useful knowledge from the massive data sets generated, the field of environmental health sciences should get a better understanding of the entire range of gene environment interplay on both sides of the gene environment equation.

Environmental Health Ethics

The easiest way to describe ethics is to contrast it with morality. Morals, often known as morality, are a person or societys essential ideas or convictions that identify what is most significant, useful, or right in terms of behaviour and character. Ethics is a more formalised version of morality. Ethics may imply When presented with an ethical challenge in professional life, one may consult any or all of these formal morality notions. Ethics is more than just defining the morals of a person, organisation, or society. Instead, it is a prescriptive process in which we decide what we should or ought to do: Marx and Engels said, Philosophers have simply interpreted the world in different ways; the objective is to transform it.

Ethics is simply a linking or interpretative language that assists us in understanding our everyday acts in the context of society and the environment around us. Hence, when we use an ethical notion like justice, we may be referring to a single fair deed by a person, a national endeavour to minimise health inequities, a campaign to reduce international debt, or even a conviction that the cosmos maintains all occurrences in balance. Employing a notion like justice draws attention to the parallels between individual acts such as one person honouring a pledge and bigger organisations such as a government establishing a fair system of taxes. We preserve a sense of consistency with respect to a wide variety of activities by employing core ethical ideas such as justice to refer to actions in relation to a large scale of people and organisations [8], [10].

Beginning students of ethics frequently regard moral beliefs as essentially private and believe it is inappropriate to make moral judgements about the conduct of others; however, they quickly learn that friends and professional colleagues frequently have genuinely useful and justifiable ideas about what is right for themselves and others. Similarly, most environmental health choices include and influence a large number of individuals, therefore what is correct in ecosystem quality can never be determined only by the opinion of a single person. As a result, most declarations of ethics in environmental health practise reflect the agreement of professional bodies and committees tasked with developing principles to guide practise.

Ethics in Environmental Health

Since the environmental health professions are varied and in the process of developing a shared sense of identity, environmental health ethics as a cohesive concept is still in creation and depends on a broad range of sources. This section traces the origins of environmental health morality and identifies some of its roots. The study of environmental hygiene and ethics has a long history. Scholars disputed the degree to which the earth was designed to produce its richness for human wellbeing and the extent to which people had a duty to perfect nature for human benefit throughout the classical period. Early modern

thought pondered the potential for human dominion over nature as knowledge and industry entered its infancy, whereas mediaeval reflection questioned if environmental harm to the planet originated from human misdeeds.

With the growth of statistics and health surveillance in the seventeenth century, the study of population growth and macroeconomics in the early nineteenth century, the growth of occupational health, sanitarian, and public health movements throughout the nineteenth century, and the modern medical revolution in the early twentieth century, the work of environmental health occupations diversified in modern times. The twentieth century also saw a rise in the diversity and specialities of all health professions. Several of todays environmental health professional groups were founded in the early to mid-twentieth century. The majority were related to industrial and occupational health. The American Academy of Occupational and Environmental Medicine ACOEM was one of the first medical speciality societies to be established in 1916. In 1942, the American Association of Occupational Health Nurses AAOHN was founded as the American Association of Industrial Nurses, AAIN. When the environmental movement gained traction in the 1970s, a slew of new environmental organisations sprung up such as the Environmental Protection Agency. Environmental regulation expanded in tandem with the growing awareness of environmental concerns.

As a result of these advances, numerous new environmental health professions have emerged. The evolution of ethics in environmental health is therefore inextricably linked to the evolution of ethics in the health professions as a whole. While each profession approaches codes, oaths, and ethical statements differently, they nonetheless share a set of fundamental concerns and values. The Code of Ethical Behavior 1993 of the ACOEM places a high value on safety, scientific integrity, and honesty. Like with many professional standards, it promotes individual secrecy and privacy while matching this with relevant but restricted disclosure to employers. It acknowledges responsibility for informing people and organisations about occupational health concerns and addresses chemical dependence and misuse.

The AAOHNs Code of Ethics 2004 is remarkably similar to the American Nurses Associations Code for Nurses ANA. It includes a nondiscrimination declaration, encourages cooperation with other professions, respects privacy, promotes community service and public health, and encourages members to stay competent and engage in educational and scientific endeavours. It pledges, like many nursing professional codes, that the professional will protect patients from the unethical or unlawful activities of others. Ethical codes are useful and should be reviewed and referenced on a regular basis. Its primary goal is to convey the broad direction of proper purpose and dedication, as well as to reflect professional idealism while providing criteria that determine minimum standards of behaviour. So, for example, an idealistic environmental health professional could use such a code to advocate for tighter limits on the release of particulates into the air, whereas a licencing board could use the same code to criticize a professional who accepted bribes in order to suppress potentially costly health data to an industry.

Since all health professions must deal with comparable ethical dilemmas, a clinical nurses comment, for example, may be instructive to environmental health practitioners. Similarly, previous leaders words may add weight to modern actions consider Florence Nightingales assessment that quantity of medical knowledge can decrease the obligation for nurses to do what nurses do, that is, regulate the environment to promote good life processes Nonetheless, when professionals make difficult judgements, ethical guidelines are frequently restricted in their applicability. These codes indicate a wide agreement, and areas of contention are often left out. Since the codes are limited in this way, other domains of ethics have emerged to handle wide concerns of disagreement and change.

Two of these disciplines emerged in the 1970s. The first of them, bioethics, was coined by Van Rennselaer Potter in 1969. Potters theory was that biology and the humanities needed to be brought together in order to respect and integrate health and the environment so that people might endure the environmental catastrophe with dignity. Under the umbrella of bioethics, a case study of the ethics of the health professions and clinical treatment developed. This branch of research has led to the recognition that rules

of professional ethics must be anchored in wider ethical principles It has also had an impact on the specification of details, regulations, and procedures that clarify notions such as patient respect, secrecy, informed consent, care for the dying, and so on. As a consequence, standards of professional ethics are increasingly addressing these challenges with caution.

The environmental obligations of the health professions are sometimes addressed in position statements that are independent from codes of ethics, sometimes by the professions themselves and sometimes by activist organisations. Major social organisations statements on the health and the environment are extremely informative, inspirational, and clear. We increasingly recognise that the health and well-being of our families relies on a clean and healthy environment, for example, according to the Declaration of the Environment Leaders of the Eight on Childrens Environmental Health. The Earth Charter, like the Rio Declaration on Environment and Development, makes an important declaration encouraging a united effort for both human and environmental healthSuch pronouncements not only provide definition and idealism to the profession, but also provide authority to its acts and suggestions.

Ethics and Sustainability

This is one approach to express the sustainability concept. The Global Commission on Environment and Development 1987, often known as the Brundtland Commission, defined sustainability as development that satisfies the demands of the current generation without jeopardising the needs of future generations. Both of these expressions imply that ethical debate must address the long - term goal, that is, across multiple generations. What is the significance of this idea to environmental health. Significant environmental health technologies and initiatives, such as those involving sewage, agriculture, alternative energy, and nature restoration, are intended to benefit several generations. Why Since human health demands are lifelong and largely constant, planning for health across the average life span commits us to preparing for the majority of a century. We care about humanity's future wellbeing, and future people will have comparable health needs and concerns. The earths decreasing ecosystems are now weakening the environments capacity to sustain human health. These reductions occur across decades to centuries, thus environmental health experts must plan for the future alongside the present.

Environmental health initiatives must be costed across their whole life cycle. The expenses of extracting and processing the resources used in creating or constructing anything through the costs of shipping, packing, and consuming materials and products toward the costs of disposing of supplies, tools, equipment, and structures after they are retired are all part of the life cycle. So, for example, if a municipality decides to build a sewage treatment plant, it must consider not only the local health benefits but also the carbon cost to the atmosphere of fuel expenditures to process the sewage and the environmental costs of mining and harvesting materials, producing energy, and shipping in order to build the plant in the first place. Alternatively, a community may decide that blowing up an old munitions plant is the best way to prevent it from polluting a local aquifer as is being done in Nebraska, however the community must first consider whether explosively dispersing those toxic materials into the atmosphere is truly a sound alternative. When the complete life cycle environmental costs are evaluated, it is not always evident that massive physical projects are the best long-term solutions to health concerns.

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