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The Earth as a basis of World Economy

by

W. J. Stein

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D. N. DUNLOP

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THE EARTH AS A BASIS OF WORLD ECONOMY

by

WALTER JOHANNES STEIN
PH.D. (VIENNA)

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Preface

THE following pages were originally written, two years ago, at the suggestion of Mr. D. N. Dunlop at a time when he was Chairman of the Executive Council of the World Power Conference, and when he had asked me to think out a scheme for the organization of a conference on World Economy. After a close friendship which had existed between us for many years, Dunlop had called me to London from the Continent, with this work in view. His premature and sudden death put an abrupt end to these particular plans, but he hoped to the last that the ideas now expressed in this book would be elaborated in the direction he indicated.

Since he is, in this way, intimately connected with what I have tried to present here, I feel it right to say something in this Preface about his life, his ideals, and his practical achievements. He was a most far-seeing man, with a remarkable faculty for organization, and a delicate perception for the "right moment" in all opportunities that presented themselves for the furtherance of his world-wide projects.

He was born in Ayrshire, Scotland, in 1868, and began his career with a training in engineering; in 1896 was employed in the American Westinghouse Electrical Company, becoming later assistant manager and then manager of its European Publicity Department. In 1911 he helped to found, and became secretary and then director of the British Electrical Allied Manufacturers' Association in London, known as the B.E.A.M.A. He did an immense amount in assisting the development of the British electrical industry generally, and towards the close of his life was elected independent chairman of the Electrical Fair Trading Council.

These things constituted the general background of his business activities, including participation in many other organizations. But a man of his calibre and insight could not rest satisfied with work into which he could not draw

far wider horizons. He was interested in the whole of humanity. And though he could speak no word of any other language but his own, he was always immediately "at home" with individuals of every nation.

He was deeply impressed with the idea that modern technical science, which was so tremendously and increasingly powerful as a destructive factor in civilization, should find a compensating position as a wholly beneficent and constructive force. So a year or two after the war he commenced to organize—at first without any assistance whatever, and later with the support of the Council of the B.E.A.M.A.—the institution, now a permanent organization, known as the World Power Conference. From many conversations I had with him, as well as from subsequent events, I know that he regarded the institution of the World Power Conference (an affair in itself big enough to satisfy the ambitions of most men of fifty-five) as only the beginning of a series of steps intended by him to lead to that entirely new orientation of science and industry which was mentioned above, and the foundation of a World Economy.

The inaugural meeting of the World Power Conference, attended by over a thousand delegates and members from forty different countries, took place in 1924 at Wembley, and was opened by the present Duke of Windsor, then Prince of Wales. (It is worth noting that for the first time since the war Mr. Dunlop succeeded in bringing both Germany and the U.S.S.R. together in an international, privately organized conference.)

In a statement of the aims of the World Power Conference, published in the journal *World Survey*, it is said that it is intended: "to form a link between different branches of power and fuel technology; between the experts of the different countries of the world; and between engineers on the one hand, and on the other hand, statesmen, administrators, scientists, and economists." At the first meeting: "the papers presented centred round the problems of making an inventory of the natural resources of the world, in power and fuel,

and using these resources to the greatest possible advantage."

A report of the first World Power Conference in *The Times* (July 2, 1924) says:

"The representatives . . . will meet together to consider and discuss the fundamentals of a series of connected problems, on the proper understanding of which the future development of the world, and the progress of its material and social welfare, must very largely depend. . . . The main consideration, underlying and overriding in importance all others, will be the need for a common spirit of enterprise and complementary effort among all the nations of the world in the endeavour to harness the forces of Nature for the common good."

The great interest evinced by the Prince of Wales in the World Power Conference, and his speech at the opening, went far to making its inauguration an outstanding success. Its subsequent development under the guidance of Mr. Dunlop (he was Chairman of the International Executive Council) was as brilliant as it was sound. But his death on May 30, 1935, left the future orientation of his great work still unorganized; although a few months before he died there appeared the beginnings of his next step in the publication of the journal, founded by him, *World Survey*. This was discontinued after his death.

Some years earlier he had told an intimate friend that he also hoped to establish what he described at first as a "Foundation" in connection with the World Power Conference, for investigating on the same comprehensive lines the uses and abuses of electricity in healing; and for promoting special researches into allied departments such as agriculture, etc. His immediate aim was, however, to assist towards the final establishment of a system of World Economy.

The plans he had embarked upon were not pursued to a further stage after his death by the organization of the World Power Conference, which seems to have resolved only to continue Mr. Dunlop's idea of extension into the domain of economics in so far as economic

problems directly connected with Power and Water Power are concerned.

As I see now, two years after his death, that his far-reaching plans have been forgotten, I have resolved to make this uncompleted plan known, in order that future promoters of a World Economic Conference may make use of the foundations which we had worked out together.

The reader of the following pages will remember that they are written by a single individual, whereas in truth the collaboration of the scientific institutions of the whole earth would be required to bring what has been outlined to satisfactory and complete fulfilment. More than this—the contents of the book show that the existing institutions will have to be developed and extended in new directions if the great goal is to be reached whereby a comprehensive economic science may become the basis of a World Economy that really does embrace the whole earth.

If order is to be introduced into the chaos of World Economy, raw materials and the laws of their distribution must be traced back to their cosmological origin. Astronomy, geology, mineralogy, botany, zoology, and geography must collaborate. Even palaeontology and the sciences which study earlier conditions of the earth and the universe must be included. This book shows that this is not the dream of a mind remote from actualities, but the practical solution of urgent and topical problems, such for example as that of over-production and the distribution of raw materials.

Problems are brought forward here which have not yet been visualized on such a scale, and solutions are suggested which could become actualities if means were found to lift them out of the whirlpool of opinions and base them upon new and comprehensive investigations. It has only been possible to give an outline of these investigations for they are concerned with problems which evince every day the vitality of economic circumstance, and can only appear through the daily recognition accorded them by institutions of world-wide scope; and therefore they cannot be brought forward by one individual alone.

It will be pointed out in the following pages that considerable knowledge actually now in our possession is not applied in the economic sphere; and that all industrial institutions must be so organized as to allow of the free distribution of the knowledge that is required. It is a question of an exposition of what is now demanded by the conditions of our time, namely, of the organization of all the sciences in the service of industry.

Originally a mathematician and physicist, I endeavoured to combine these basic sciences with that urge towards knowledge which is expressed in pure philosophy, in which I took my degree in the University of Vienna. Subsequently I turned my attention to history, and for thirteen years studied (and taught) the growth of human institutions and their dependence upon climate and cosmological facts. But for a long time I was also impelled to include in my work the special problems of industry and statistics; so that when the time came for my collaboration with Mr. Dunlop I found it at last possible to apply these studies to concrete practical affairs.

Having now succeeded in clarifying many special problems of industry, especially their significance in the light of statistics and their application to practical problems, I feel the need to place before a wider public what should become common knowledge, if future industrial and economic arrangements are to be effective in a positive manner.

In this way, then, my endeavours are directed towards sketching an outline of the second step planned by my friend D. N. Dunlop; a step not now possible of fulfilment quite in the direct line of continuity which he had visualized when he founded the World Power Conference. He was a great man, whose innate modesty forbade him to seek for personal recognition. To the memory of him, whose only desire was for the welfare of humanity, I dedicate these pages.

LONDON
May 30, 1937

Introduction

THE purpose of this work is to show that the earth as a whole is the basis of world economics. The social organism, and that part of it which is embodied in economic life, can be modified by man; but it is governed by laws peculiar to itself, and man's intrusion must necessarily introduce modifications which do not wholly conform to what he himself originally intended. In consequence it can happen that man is overwhelmed by these economic forces, and thus is deprived of the conditions which alone permit him to live. Man, in fighting to preserve his own human sphere, comes constantly into contact with economic forces which in their effect are analogous to and which work in the same way as the primitive forces in nature. Whatever he does must either run counter to or in conjunction with these peculiar forces in economic life, and to achieve a standard by which he can enjoy life while expending the minimum of unnecessary effort, he must be continually struggling against the forces of economic life. This specifically human sphere in the realm of economic forces is another constituent part of the social organism.

It is true that both individually and collectively man is able to inaugurate many processes in social or economic evolution; but the economic system is not the result of human activities alone, it is a part of the earth itself. It is the present-day tendency to be concerned only with individual nations and groups, and to regard the earth only as the stage on which the action takes place, as the mere provider of raw material. If we conceive economic life as forming part of the life of the whole earth, the complexion of the matter changes entirely, the inexorability of the economic forces largely dis-

appears and man is thus enabled to build up his own sphere.

The conception of the earth as a *whole* engenders a form of moral impulse which, unlike that of the Orient as exemplified in its philosophy and its religion, is not moral through any conscious act of the will, but is based on an objective comprehension of the equilibrium of all surrounding forces. It is not necessary to wait until all national and group egoism is abolished before economic life can be purged; it is enough that common sense should be generally applied with the earth as a whole taken as its basis. To obtain a sensible view of the earth we must see it not as an inanimate clod but as a living organism whose powers are balanced, and whose life-force runs into its furthest extremities, demonstrating the principle of the whole in every part, and the way in which the welfare of each such part is bound up with the welfare of the whole. It can be perceived thus, that the earth should be regarded not only as a living organism but as the producer of moral stimuli also.

To be convinced of the earth's separate life we need simply take a plot of land as an example. In observing the plant life which grows there it is hardly enough to ascribe this life to the plants alone; the earth which produces them must be alive too, for the earth is not simply the supplier of chemical substances for the nourishment of the plants; the soil does not represent mere dead, chemical matter. It is this spurious line of thought that has led to excessive use of artificial fertilizers; for in that procedure no account is taken of the soil as a living organism. Plants and soil together make a living unit in which the life of the one part is balanced by the life of the other. In a garden, the root plant will thrive best when it is grown in near proximity to the flowering plant. In a cornfield we find sainfoin. In the kitchen garden the horse-radish and the potato flourish

side by side by reason of the piquancy of the one and the mildness of the other. The same relationship exists between plants and their soil as between one plant and another. Definite types of soil suit certain plants. In the same way as plants, by secreting salts in their roots tend to become mineralized, so does the soil by producing plants become a living organism, going as such through the seasons and taking part in cosmological processes, the seasons themselves being the result of the relationship between the earth and the cosmos. It is not, therefore, sufficient to describe the earth solely from the chemical point of view; it must be described from the cosmological point of view too; for not only do the processes of growth, blossoming and fruit-bearing vary with the seasons, but, as it has been experimentally proved, so also do such phenomena as crystallizations.* This would imply that the cosmological constellation and the cosmic life are at work on every plot of land.

What is true for a small plot of land is equally true for the whole earth, and this is the basis of economic life. The living earth, regarded as the foundation of economic and social life, presents quite a different aspect in the understanding and solving of economic problems, from the earth when looked upon—as it usually is—as a mere object of exploitation.

As a planet, the earth is undergoing many phases of geological evolution. These involve manifold transitions in all forms of human, animal, plant and planetary life, in accordance with the changes in climatic conditions. Each stage of development is the basis for the succeeding higher one, and although it is the most primitive that appears first, the forces which make for the higher forms are already at work. Were this not so, the lower forms would lack the impetus for development since environ-

* *Mitteilungen des Biologischen Institutes am Goetheanum No. I*, by L. Kolisko, Stuttgart, 1934, p. 43.

ment is not its sole cause. If, in our conception of evolution, we consider these inherent powers that are active from the very beginning, we must see in the lower forms of life incomplete attempts to produce the higher forms. We see these stages of life represented in organisms of different complexity, as the graduated expression of plastic powers at work during the whole process of evolution. Thus we see that its crown and justification, Man, who has appeared at last as the highest form of organization, was, in the more primitive stages of evolution, working as a creative power.

We must, therefore, form our picture of world evolution in a twofold way. To consider stages of form one following the other in the realm of the visible world, is to obtain a different picture from that of the forces working through all these forms. That which appears last in the plastic form, is, from the formative point of view, the first. Applied to the human being, this shows that he is representative of the last and highest form in the whole of evolution, but that, as an expression of creative powers, he represents those forces which have been at work since the very beginning.

Man is thus a creature, that is to say, a phenomenon in the process of evolution in the same way as are other creatures; but in him the universe becomes conscious of itself, and in the form of perceptive thinking, it is able to understand the creative powers. Man must then be recognized as the being in which all these creative powers are embodied, holding thereby dominion over all nature and living things. In awakening to his own responsibility for the whole, man becomes aware of himself as a social being.

No social work is possible without first increasing this feeling of social responsibility. As we look back into history we find that all important social changes were wrought through a new ideal which succeeded in in-

creasing this feeling. The proper stimuli for present-day problems could be aroused if nations and individuals could be brought to realize their responsibilities towards the world as a whole. Social problems should be approached first by considering the earth and its evolution. How can we succeed in solving the urgent questions of the present day, and while seeking for these solutions bear in mind our full responsibility for the whole of the earth, a responsibility towards which the spirit of our age is leading us more and more? How can we come to an understanding between its various groups imbued by a feeling of responsibility for the whole? We can do it by constantly remembering the evolution of the earth and its creatures, and by contemplating its magnificent harmony. Then, filled with this impression, we should attempt to solve the social problems. Let us, therefore, begin with a reverent attitude towards the magnitude of nature, and end by realizing the urgent need for social action.

Chapter I

The Earth as a Star among Stars

WHEN great works have been left incomplete we always feel an impulse to expand the thoughts they contain. We experience this feeling in reading Herder's *Ideas regarding the Philosophy of the History of Mankind.* In this book an attempt has been made to conceive the whole of human history in relation to the earth's climatic and cosmological conditions. Herder opens his work with the words: "The earth is a star among stars." And he has had the courage to carry out concrete investigations on a cosmological basis. Any serious enquirer into the economic conditions of the twentieth century must have that same courage. In the nineteenth century, man's vision was dominated by natural science; a new world-conception was given to him on that basis; but in the twentieth century, economy became earth-embracing as a consequence of technical inventions and the modernization of transport and communications. This has brought about not only change in economic activity but a change in the whole character of economic life. In the nineteenth century, the science of economics belonged to man. In the twentieth century it has become a part of nature, a part of the planetary life in which individual personalities and individual groups fight for their existence against impersonal forces.* This tremendous change finds its expression in the fact that in the year 1879 the word "economy" was first substituted for the word "national economy."†

The actualities moved more quickly than the thoughts and theories which sought to describe and explain them.

* See Fred Henderson, *The Economic Consequences of Power Production*, George Allen and Unwin, Ltd., 1931–3, p. 22.

† Marshall in *Economics for Industry*, 1879: see Collin Brooks, *The Economics of Human Happiness*, George Routledge and Sons, London, 1933, p. 110.

In consequence, while we have a world-embracing economy, there is no existing representative administration. All that we have are the existing organizations which represent the old economic group interests. Hence it is that politicians are still the moving forces in the realm of economics, and economics as a science remains embodied in the science of politics instead of being part of the system within those sciences which are occupied in studying the earth. Geology, geography, meteorology, climatology and even astronomy should be more closely allied to modern economics than should politics, for we are, in reality, on the way to turning politics into folk-psychology. The old units of economic life within the national groups are powerful, but they lack a real field of operation, because this field is the earth which belongs to all mankind. This can be demonstrated in manifold ways. Wheat, for example, is a commodity of which the earth is in constant need in ever greater quantities. Even in the East where rice would seem to take its place, there are signs of an increased preference for wheat. One would imagine that those who are engaged in the production of this all-important world commodity would be able to satisfy their own needs, yet we find that owing to large and unsaleable stocks and the consequent reduction in prices, the farmer does not obtain a living wage.

International organizations have come to life and have attempted through restriction to regulate and balance production in the various wheat-growing countries. Agreements have been reached, yet even then they have been ignored by some states. Finally the earth herself, interfering by means of meteorological forces, produces an entirely different yield of the crops from that which was originally expected and planned by man. Yet the earth has no representative sitting at these organizations, although she is a power by no means inferior to the leading states. The whole premise that underlies these negotiations is misleading because there is really no such thing as the overproduction of wheat. This interesting fact finds ample proof in that excellent treatise

Le Problème Mondial du Blé by Paul de Hevesy,* who made a most thorough and detailed investigation covering not only the situation over the whole earth but in each separate country. He points out that the unsaleable stocks which really undermine the market, when seen in the light of the whole of humanity, represent nothing more than a necessary reserve to protect man against famine. These reserves represent a quantity of food sufficient to provide for humanity for fifty-four days. The real problem is not primarily, therefore, the necessity for reducing production, but rather the financing of this reserve† which, though needed for humanity, must be kept out of the market in the interest of wheat-producing countries. The difficulty of our present situation is that humanity as such is not organized and has neither a representative body nor the financial means. The need for such an organization is therefore pressing. Its executive council, however, must be of a different composition from that which is customary to-day. Not only should the direct representatives of the States have a seat, but the delegates of the grain-producing associations should be there, not as delegates under the orders of their country, but to represent economic life itself. There should, in addition, be representatives of the distributors and the consumers, and even of the earth itself, experts in meteorology, plant geography, and so on.

This necessary step is much greater than it might first appear, since its aim is the entire reorganization of economic life itself, a reorganization which must see eye to eye with the political organizations in matters of national psychology. Organization of labour, the share of single nations in the total production, the quota of working hours, the balance of the standard of living in various countries—these are some of the questions which will have to find their solution within the framework of national and international agreements. These important

* Paul de Hevesy, *Le Problème Mondial du Blé*, Libraire Felix Alcan, Paris, 1934.

† See M. D. Dijt, *Conjunctuurbeheersching door Goederenschappen*, D. B. Centens, Amsterdam, 1933, and Ir. J. Goudrian's theory of "grondstoffen valuta."

economic questions, however, cannot be solved between nations (that is, through conflict of national views), but on purely economic grounds. What has been said regarding wheat applies, in much the same way, to most other products. What is needed is the application of a world-embracing economy. We must not allow ourselves to be turned aside from this purpose by the fact that today most countries are attempting to solve their economic problems within their own frontiers. That this is impossible is much more clearly shown by the results of such experiments than by any theoretical argument. The economic isolation of a country through the closing of its frontiers would inevitably lower the standard of living of its population. And not only that: the attempt to produce possibly all within their own boundaries causes trouble for other countries which could produce some commodities or raw products absorbed before from the other, now self-sufficient country. But we can believe that no country attempts to be self-sufficient for reasons which already show us the attitude of self-dependence. Let us take for example Germany. In Germany we see the great attempt to complete all means to be more and more independent from other countries. For example the special edition from the 23rd of January, 1935, of the Weekly Report of the German Institute for Business Research shows how Germany is trying to be more and more independent in her supply of fat from other countries. She still has a lack of 1·3 million tons and hopes it should be possible to produce 0·607 million tons more. But it is clear that this and other similar measures are consequences of facts not really created by Germany but by other countries and not explicable through any other factor than necessary pure economic reaction. To say: Here we have the proof of German nationalism, would mean not to consider the history of the evolution of such measures. What is it that has put Germany in the position in which she is now? There is only one true answer: The overcoming of economy through policy. "Since 1918 Economy has been overwhelmed through policy," says Hjalmar

Schacht in his lecture on the *International Debts and Credits.**

According to the financial provisions of the Treaty of Versailles, Germany was required to pay on Reparations Account a sum which was the equivalent of half the tax revenue of the Reich in previous years. From 1920–24 the date of the inauguration of the Dawes Plan, Germany had to pay 42 thousand millions gold marks, which payment it was agreed should take the form of a transfer of securities. Under the Dawes Plan Germany had to pay $2\frac{1}{2}$ thousand million gold marks. This sum was reduced by the Young Plan to 2 thousand million gold marks. This money was paid under external political pressure. But the actual method by which reparations were paid was quite different from what the Allied and Associated Powers imagined it would be. The Allied Powers envisaged a payment by Germany, but in effect it was they themselves who paid. The best financial arrangements made on paper must always depend on their fulfilment in actual trade and exchange transactions in ordinary commercial life. What really happened was that the sum that Germany should have transferred really remained within the country in the form of credits granted. By the countries receiving reparations, Germany was thus granted the enormous credits which Dr. Schacht points out were more urgently needed by the economically less highly developed countries of Latin America, Asia, and Africa. If Germany were really to have paid the large sum in reparations that were demanded, it would have been necessary for her to have increased her exports to an amount corresponding to the yearly tribute. To transfer large sums a favourable balance of trade of the same order is necessary. But the world was not prepared to permit such an increase of exports coming from one country. The B.I.Z. had to recognize that it is impossible. Germany, unable to do what she should, restricted her

* *Internationale Konferenz für Agrarwissenschaft Bad Eilsen Niedersachsen*, August 26 to September 2, 1934. Vortraege und Verhandlungen, Hans Buske, Leipzig, 1934.

imports in order to save foreign exchange and this cannot be called Germany's nationalism. Nationalism in the field of economy is impossible, is a contradiction in itself. Even in the time of growing nationalism the interdependence of the nations increases—because economy is founded on this interdependence and nationalism or policy is based not on an economic principle but on history and psychological facts. It lives in quite another sphere of life. The relative dependence of all as it works in economy upon all is simply the principle of division of labour that has everywhere resulted from modern economic life. To lose this principle would lead us back to an economic level below our present one. The other stream in which we move—the development of group-characteristics—expresses policy: nationalism is psychological and not economic.

These reflections should be enough to show that a reasonable purpose can be seen in both national and in earth-embracing economic evolution. But national life deals with man in his historical and psychological evolution; it is the continuation of the individualistic stream into individual group-characteristics, while economics deals with those things which must be understood in their connection with earth and nature. As a nation lives in the memory of its history, so must economy live in contemplation of facts concerning the whole earth; and for this purpose we need an earth-embracing economic learning.

"The Earth is a star among stars," writes Herder. He thus draws our attention to the earth as a living unit in relation to the surrounding heavens. For not only the seasons but the great climatic changes which gradually take place during our planet's evolution are an expression of that relationship. Man is beginning to gain ascendency over these natural forces; for instance, arid areas have been irrigated in the U.S.A. on a large scale; and it is hoped to change the character of those areas—to change, in fact, the climate of the whole American Continent—by such measures.*

* *World Atlas of Commercial Geology*, Department of the Interior, John Barton Payne, Washington, 1921: Vol. I, *Distribution of Mineral Production*;

Ellsworth Huntington, who has studied the importance of climate in the evolution of human culture, and has described the historical evolution of mankind from this point of view, comes to the conclusion that it is man's task to make himself master of the climate.

There is no doubt, when we consider the increasing perfection of our technical means and the large scale of modern social work, that sooner or later this mastery will be achieved. The very fact that we are progressing along these lines increases our responsibility for the whole earth. For the earth is a living unit, and every living unit follows the law that a change in one of its parts affects the whole. It is beyond doubt that irrigation of a large area such as, let us say, the Sahara, would have a changing influence on other, perhaps far distant, areas. Our knowledge of the earth as a whole is not yet sufficiently developed for us to predict the exact effect of such measures. On the other hand social conditions demand that we should work to further our knowledge in this direction. There are, of course, numerous sciences which deal with this problem, such as Geography, Meteorology, and Physics. But these sciences are only concerned with their own particular aspect of it, and though the Carnegie Institute has done much valuable preparatory work in this direction we are without an institution whose sole task it would be to harmonize all the different aspects of the natural sciences and to work upon this basis for the social purpose of benefiting the whole of mankind.

We know that the existence of arid areas on the earth is by no means accidental; for the heaviest rainfall is found in those parts of the earth where the great air currents are in an ascending direction, while the arid areas are found in that zone where the air currents turn down again toward the earth. On the other hand, however, other areas have dried up owing to the destruction of forests. But it will be necessary to consider all these

Vol. II, *Water Power*, gives a picture of the extent of irrigation. This activity has since been considerably extended. See the current number of *Civil Engineering*, U.S.A.

questions not only from the point of view of one country but from that of all countries. It would be of the greatest importance for the encouragement of economic thinking if by means of natural scientific research it could be clearly shown that the earth is an organic whole and that it is impossible to interfere with one part without serious consequences in other parts. The works of Henryk Arctowski are of the utmost importance in this sphere, because he proves that excess and lack of warmth in certain areas are connected with distinct laws. The study of the latest literature dealing with the distribution of warmth, rainfall, and pressure, gives the impression that all these writers, although working within a very specialized field of research, often have, unconsciously, a common aim. It is as though the spirit of our age required man to realize that the earth is a living unit. The organization of natural science, however, through its intense specialization, ensures that even the results already proved by experts shall not be common knowledge, and cannot, therefore, be used for economic purposes yet. It is this very aspect of natural science which our present-day economists, business men, and politicians need in dealing with economics. Not until this is commonly understood and accepted can there be any hope for a solution of the pressing economic problems of everyday life. Two important English historians, Thomas Buckle and W. E. H. Lecky, have shown clearly in their works that there can be no progress for humanity until certain fundamental truths are absorbed by the general consciousness of the peoples. Therefore neither individual egoism nor group egoism can be overcome in economics without a clear understanding of the fact that, whether we are individuals or states, we are, in the realm of economics, parts of one living organism.

Such an idea can become operative only when institutions are created which, through their activities, furnish constant proof of its truth. These institutions must be universal in character. They must deal with each single problem in the light of the whole earth and its cosmology.

The practical question might arise, for instance, as to whereabouts coal mines are to be found; and whether it is possible that at some future time technical means might be found for their development and utilization even should they lie under the sea. The answer to such an entirely practical question can only be given by the science of cosmology.

The distribution of coal in the earth is quite uneven. Brown coal as well as ordinary coal is concentrated in the northern temperate zone, while there is very little to be found in the tropics and in the southern parts of the earth. And for this reason Europe and Northern America have economic advantages over the southern continents. To understand the causes of this uneven distribution we must have recourse to a cosmological survey, since the causes are cosmological. Coal belongs to all geological epochs, but changes its quality and character with each epoch, thus:

Archaic coal	=	graphite
Palaeozoic coal	=	coal
Mesozoic coal	=	coal
Tertiary coal	=	brown coal, or lignite
Modern deposits	=	peat

Damian Kreichgauer, in his book *The Position of the Equator in the Different Geological Epochs*,* shows that the crust of the earth is moving in a certain measurable way over the core of the earth. Consequently new parts of the surface of the earth become North and South Pole, and other parts become Equator. However, in each geological epoch there have existed two belts of mountains which encircled the earth and cut across each other almost at right angles. Owing to the shifting of the earth's crust in relation to the core, however, these systems of mountains covered different parts of the earth in each epoch. The tertiary, as well as the carbonic, mountain systems, which represent the main deposits of lignite and coal, are, to-day situated in such a way

* Damian Kreichgauer: *Die Aequatorfrage in der Geologie*, 2nd edition, 1924: Missionsdruckerei, Steyl, Kaldenkirchen, Rheinland.

that their bulk lies in the northern half of the earth. This shows that without cosmological knowledge, a simple question dealing with the distribution of raw materials cannot be answered. It is, then, necessary to describe in the next chapter the cosmological and geological metamorphoses of the earth during the different epochs.

Chapter II

The Cosmological and Geological Aspect as Foundation for the Distribution of Raw Materials on the Earth

RECENT research on the phenomena of earthquakes has proved, through the measurement of the discontinuities of the wave transmissions which precede or accompany an earthquake, that the interior of the earth consists of several clearly distinguishable strata. Of these one is the earth's crust, which is approximately 35 miles (50 to 60 kilometres) thick.*

Damian Kreichgauer, in a special study of the movement of the earth's crust,† has ascertained the position of the poles during the different epochs on the basis of geological considerations, and has verified his findings through the study of the plant and animal distribution. He thus affords a comprehensive explanation of climatic changes, and their effects upon plants and animals. As the earth is not a globe but has the form of an ellipsoid or geoid, the movement of the crust over the interior must result in pressure and extension. These extensions and pressures have left very distinct marks on the surface, which show the formations of mountains. These formations are evident in all epochs in the form of the two already mentioned belts of mountains, which cross each other at those points where the crust turns. In

* See the works of Wiechert and of his pupils, K. Zoepritz, L. Geiger, B. Gutenberg, in *Nachrichten der Ges. der Wissenschaften in Goettingen*, Mathematisch Physikalische Klasse, 1907, p. 415; 1909, p. 400; 1912, p. 121; 1914, p. 125; 1925, p. 251; also Ernst Tams, *Die Konstitution der Erdrinde in Petermanns Mitteilungen*, Supplement 208, 1930, p. 83 f.

† Damian Kreichgauer, *Die Aequatorfrage in der Geologie*, 2nd edition, 1924, Missionsdruckerei, Steyl, Kaldenkirchen, Rheinland.

discussing Kreichgauer's thesis, Theodor Arldt, in his excellent book, *Palaeogeographie*, raises the objection that such a shifting of the crust ought to have left visible signs on the surface, showing surprise that Kreichgauer does not refer to it. But Kreichgauer's work provides evidence that such signs are manifest in the whole formation of mountains over the earth. According to him the North Pole during Praekambrium (namely directly after the beginning of the Palaeozoikum) was situated in South Oceania. Then it moved along the line between Hawaii and Mexico towards Mexico, where the pole is to be found during the carboniferous age (within the Palaeozoikum). During the cretaceous period (Mesozoikum) the pole is to be found in Southern Alaska, and in the tertiary period (Kaenozoikum) in Western Alaska. From there it moved over the Parry Islands and Baffin Land and during the "Diluvium" it was in South Greenland, moved on along the east coast of Greenland and arrived in its present position during our epoch. The various climatic changes on the earth's surface are connected with this movement of the earth's crust over the interior.

The systems of mountains which we find on the earth to-day show an equatorial and a meridional belt. The equatorial belt consists of the Atlas mountains, Pyrenees, Alps, Carpathian mountains, Balkan mountains, Crimea, Caucasus, the mountains of Asia Minor and Armenia, the Iran Plateau, Hindu Kush, Pamir, Tien Shan Mountains, Kuen Lun, Karakoram, Himalayas, the Plateau of Tibet, the chain of mountains in western further India, Malaya, and the Austronesian Sea, etc.

The meridional belt consists of the mountains which rise right round the Pacific from Tierra del Fuego through the whole western side of South America over the Antilles, along the whole western part of North America over the Aleutian Islands, Kamchatca, Kurile Islands, Sachalian, Japan, Liukiu Islands, Formosa, Philippines, and the Sunda Sea. Perhaps the continuation is to be found east of Australia via New Zealand and the Antarctic, back to Tierra del Fuego.

These two mountain belts cross each other in the Sunda and Caribbean Seas. Kreichgauer shows that two similar systems of belts of mountains have existed in each geological epoch. He describes, in all, five such systems. To understand the distribution of mineral raw materials, then, it is not sufficient to find their connection with specified geological formations, for it is necessary to take into consideration the movements of the crust of the earth. This applies, correspondingly, to our understanding of the distribution of plants and animals over the earth.

Chapter III

The Circulation of Chemical Substance

IN its chemical composition the earth's crust is an independent structure in which chemical substances circulate. Of this structure 99·7 per cent consists of the chemical elements, which rotate in cycles, each element of the group entering into characteristic combinations which can be formed anew again and again. In the course of more or less extended processes the element then returns again to its original combination and the circulation begins once more.

Oxygen, for example, works in this way. In living beings, organic substances play a decisive rôle in the circulation of the elements. We know that chlorophyl, the green colouring in the living plant, exhales oxygen, and that animals and man, on the other hand, inhale this oxygen and pass it on in the various combinations, breathing out carbonic acid, which is in its turn split up again by the plant world, so that the oxygen is once more liberated.

There are more than 700,000 species of organisms on the earth, which are decisive factors in the chemistry of the planet.*

According to Dumas et Boussingault,† "The animal world absorbs everything which the plants receive from the air, and passes it back into the atmosphere. We observe an eternal cycle in which the living processes evolve an incalculable variety of forms, and in which matter itself merely changes its place. In the plants, the lifeless substance of the air gradually assumes an organized form, then, without functional alteration

* H. Pratt, *Science* (2) 35 N.Y., 1911, 467, says that 522,000 species of animals have been described, and P. van Tieghem, *Traite de Botanique*, revised by Ed. Constantin, 12 P 1918, p. 633, 175,300 species of plants.

† *Essai de statique des êtres organiques*, 3rd edition, Paris, 1844, pp. 45–6.

appears in the animals, finally becoming an instrument of the spirit. Then, conquered and broken as it were by this achievement, it returns once more as lifeless matter into that boundless reservoir from whence it was taken."

The investigation of the chemical circulation of substances from a merely chemical point of view would be entirely wrong, since the interaction of living beings plays such a decisive part in the earth's chemistry. Evidence of this fact is shown by the observation that certain species of animals, which, as they become extinct in the course of the geological epochs, are immediately replaced by others which take over the chemical task previously performed for the earth by the former.*

It is a fact that certain animals are accumulators of specific chemical substances, out of which their bodies are built up. In this way, numerous sea-animals accumulate silica. The Radiolaria which have a siliciferous skeleton, belong to this classification and many other sea animals, as for example, the corals, which accumulate lime. There are also organisms which accumulate strontium, barium, phosphorus, magnesia, zinc, copper, iron, and, in particular, manganese; and certain bacteria collect iron. Manganese is accumulated by *Bacterium Manganicum* (M. Beijernick, *Folia microbiol*, *2*, Delft 1913, 126) or *Carex hirta* (H. Swoboda Carinthia, 2 192. 1902) and some species of *Crenothrix Leptothrix*, which contain up to 6–7 per cent manganite. (M. Beijernick, *Folia microbiologica* 2, Delft 1913, 128 ff.)

The circulation of chemical substances is, therefore, intimately connected with both the life and the change of species of plants and animals. Plants too collect chemical substances. Seaweed (Algae) accumulates iodine.† Several water plants collect manganese, e.g. *Zostera maritima* (C. Petersen, report of the Dan. biol. station 20, Cop. 1911. 21. and 22 Cop. 1915). Other plants collect iron,‡ etc., etc.

* W. J. Vernadsky, *Geochemie*, Leipzig, 1930, p. 202, also p. 72.

† Regarding iodine in organisms see T. v. Fellenback, *Das Vorkommen der Kreislauf und der Stoffwechsel des Jod*, Ergebnisse der Physiologie 25, 1926.

‡ H. Molisch, *Die Pflanzen in ihrer Beziehung zum Eisen*, 1892. H. Molisch, *Die Eisenbakterien*, 1910.

All plants and animals living on the land accumulate within their bodies nitrogen and carbon and many of them calcium as well.

One cannot, therefore, follow the circulation of the substances from a mere chemical viewpoint, for all planetary life must be taken into consideration, since 99 per cent of the weight of the earth's crust is subject to the influence of the living substance.*

Whether life can be explained as a complication of physical and chemical forces, is a fundamental question. Empirical research answers "no." Vernadsky deals with it in his *Geochemie* by the following statement:

> Within the bounds of empirical facts the idea of the eternity of life, which fills the philosophical and religious life of Asia in so high a measure, and which is now beginning to penetrate into our scientific conceptions of the universe also, is entirely justified.
>
> (*Geochemie*, p. 225.)

In no geological epoch do we see anything to contradict the fact that life is descending from some other already existing life. We must, therefore, trace back the life of the organisms to some other life, and that can only be the life of the planet. It is only superficially that the planet earth consists of a crust of dead substance. The earth as a whole is a living organism. It has given of its life to the organism; and, owing to this giving of life, the earth itself is dying off on the surface. Every farmer knows that not only the plant which he grows has life, but that the earth as such, the soil as such, passes during the course of the years through a manifold process of life, which needs to be fostered just as the life of the plant does. As the tree towards its periphery shows a dying process in its bark, so does the earth in its crust; and the dead substances of this crust cannot be understood without taking into consideration the life of plants and animals in their evolving cycles. The bio-sphere and the chemical substance form an inseparable unit. The conception which separates chemistry from life on the earth

* See the quantitative measurings taken by W. J. Vernadsky, *Geochemie*, p. 201 ff.

is an unfruitful, misleading abstraction. The substances of the earth must be understood in connection with the evolution and the life of the whole planet as it passes through its many geological epochs. Natural forces change its formation from time to time. At last, however, Man makes his appearance, in order that he may, when plants and animals have played their part in the shaping of the planet, give it still another form, a form which he alone, out of his consciousness, is able to produce.

The intervention of man's technique is creating a movement of substance which must be regarded as a new geological epoch, the "Psychozoikum." To quote Vernadsky:

> In the present geological epoch, the psychozoikum (the era of the spirit), there arises a new factor of the greatest geochemical importance; the geochemical activity of man.

If this is true—and it is true—an immeasurable responsibility falls upon man.

The earth has given of its life to its creatures. They have been able to unfold their own individual life and, rising step by step, at last have kindled in Man a consciousness of his own sense of responsibility. In Man the universe has awakened to itself. Goethe in his book on Winkelman expresses it thus:

> When man's healthy nature functions harmoniously as a whole, and he feels himself to be part of a great, beautiful and noble universe; when harmonized well-being fills him with a pure and free ecstasy, then the universe, could it only become conscious of having reached its goal, would rejoice and stand in admiration before the fulfilment of its own evolution and being.

Modern man so deeply influences the earthly organization of the planet, through economic activities and trading, that it is imperative to realize that any further progression implies increased responsibility.

Our objective should be not only the immediate purpose of each individual economic transaction, but our every decision and act in economic life should be

guided by the question, how does it serve the earth as a whole?

How to adjust our economic life in accordance with our responsibility towards the planet, this is what the geochemical aspect teaches us.

Chapter IV

The Cosmological Origin of Metals

IN an earlier chapter the earth's crust was mentioned as being a layer of about thirty-five miles in depth, underneath which we have to imagine conditions entirely different from anything we are able to find out by experience. All we actually know is, that during earlier geological epochs the lower strata formed the surface of the earth. Those substances which in our time have penetrated to the surface through volcanic eruption through the upper strata, formed, in the mesozoic epoch, a layer which was considerably nearer the surface than it is at present. To-day metals which have penetrated from below fill the crevices in the upper strata. This process may have taken place spontaneously, by means of gaseous action, or possibly as a consequence of the action of water. But the fact that the metals find their way from below into the crevices and pockets of the upper strata, owes its origin to cosmic rays which reached the surface of the earth from without, probably at a time when the present depths formed the surface.

The cosmic origin of the metals is confirmed by certain chemical reactions, which L. Kolisko has demonstrated in experimental research extending over many years.* It has been proved in this way that metals in solution moving against the forces of gravity (this can be done by experimenting with filter paper or gelatine) show chemical reactions, which vary with the constellations of certain planets. For example, the duration of an eclipse of the sun can be ascertained in the gold-picture which the solution of gold paints in drawing itself up in the filter paper. These experiments, which it is possible to extend into the biological realm as well,

* L. Kolisko: *Das Silber und der Mond, Der Jupiter und das Zinn* (publication of the Biol. Institute, Kanonenweg 44, Stuttgart); *Die Sonnenfinsternis Juni* 1927, *Sternenwirken in Erdenstoffen* (Orient-Occident Verlag, Stuttgart).

are of the greatest importance in our knowledge of the nature of the metals. The traditional connection between,

Saturn—lead	Venus—copper
Jupiter—tin	Mercury—mercury
Mars—iron	Moon—silver
Sun—gold	

can thus be proved to be correct.*

In olden times something was known about the cosmic connection and the origin of the metals. We find in the Egyptian language that the word for iron is *baaeuepe* which corresponds to the Coptic word *beni-pe* and should be translated "Metal of the Heavens"; and that the Hebrew word *sahab* for gold means "rayed in from the light of the sun." These words point to the metals' true origin. They actually are residues of substances derived from cosmic ray-influxes during geological epochs, in which those parts which are now in the depths were formerly on the surface.

Hence also the relationship of certain metals both to certain planets and to certain geological formations. Tin for example is connected not only with Jupiter but also with granite. "The veins of tin ore."†

Thus we must imagine the magmatic masses permeated by the influences of cosmic rays which add metal substances to their composition. That iron, however, stands apart from all the others, becomes evident as soon as we compare the relative quantities of the metals. This table below,

	Per cent		*Per cent*
Lead	0·001	Copper	0·000 5
Tin	about 0·005	Mercury	0·000 1
Iron	4·5	Silver	0·000 005‡
Gold	0·000 000 1		

* See also L. Kolisko: *Physiologischer und physikalischer Nachweis der Wirksamkeit kleinster Entitaeten; Physiologischer Nachweis der Wirksamkeit Kleinster Entitaeten; Physiologischer Nachweis der Wirksamkeit Kleinster Entitaeten bei 7 Metallen.*

† Beyschlag Krusch Vogt, *Die Lagerstaetten der nutzbaren Mineralien und Gesteine*, 2nd edition, Enke, Stuttgart, 1914, p. 466.

‡ Ibid., vol. i, p. 157, and Landold-Boernstein.

shows that iron exists in the greatest proportions. We must, then, assume that iron—contrary to all other metals, with the exception perhaps of nickel (0·01 per cent)—has come to the earth not only through cosmic rays but directly as a substance from the cosmos. The meteors, which in the main consist of nickel and iron, strengthen the belief that iron has thus been substantially incorporated in the development of the earth. Iron plays a special part in the human organization, too, for it is the only metal which exists in perceptible quantities in the blood. The coming into existence of warm-blooded animals appears to have occurred parallel with the increase of the iron-content of the earth.

Chapter V

The Oceans

TO describe the human body and to be content with merely commenting upon the human organs, would simply be to describe a dead body in which the circulation of liquid substances and the breathing had ceased. To study the life of the organism in its manifold processes it is necessary to go a step further and study the functions of the circulation, the breathing processes and so on.

In the same way, a description of the earth which is simply concerned with the shapes of the continents and the formation of the mountains, would not give the slightest idea of its mighty life processes. The eminent geologist, Eduard Suess, states in his work about the face of the earth,* that Geology can only describe the dying processes of the planet on its surface. He says: "It is the breaking up of the planet, which we witness."

This picture of the earth, however, takes on a different aspect if we make a study of oceanography, when the planet immediately appears to become alive. The ocean, bound up as it is with the circulation of water and air, and the numerous meteorological connections of the earth, is the bearer of inexhaustible life.

If we have ever experienced the impression of eternity given to us by the ocean, by its coming and going, advancing and retreating, and its mysterious rhythm, then we have understood in some way the indestructible life of the planet. Were the earth not a living organism, its body would form a crystal. This tendency does exist, but the other, opposite tendency, which is constantly counteracting the crystallization of the earth, is also there to overcome the death and paralyzation of earth life. Just as there is something in the human eye which is always preventing the lens of the eye from becoming

* Eduard Suess, *Das Antlitz der Erde.*

a crystal, so there is something which prevents the earth from crystallizing. Lowthian Green was the first to discover that the body of the earth tends to take a tetrahedral crystal form.* He shows that the four corners of the tetrahedron are the south pole, the western and central Nile valley, the coast of the Yucatan, and the Mariana Islands. The planes, however, are the oceans. Were the earth to crystallize the oceans would become glassy, dead expanses. More recent research by Theodore Arldt has placed the tetrahedral a little differently: he places the corners as follows: South Pole, Canada, Finland, East Siberia. The oceans are the planes; but they are not only that, they are the bearers of a marvellous rhythmic life.

It would be entirely mistaken to believe that the phenomenon of high and low tide are characteristic of the ocean only, for there are springs which exhibit the same phenomenon. Even in the living plant world we find the phenomenon of ebb and flood. It was already known to the priest, Lamprecht, when he wrote the mediaeval poem in which he describes very attractively an experience of Alexander the Great, where the latter notices how the sap rises in plants and trees, and how it recedes again, alternately filling the tree and returning back into the ground, so that the shape of the tree is formed by the fluid sap. Actually such things had already been observed by Aristotle, who probably taught them to his pupil. It is an old rule of the wood-cutters that those trees intended for fuel should be felled at the new moon, because at that time the sap has receded and the wood is dry. At full moon the tree is filled to the crown with sap, and a little before the new moon the sap flows back to the roots. We can observe these monthly and daily rhythms, but they are not connected only mechanically with the course of the sun and the moon. The earth as a living being reveals its rhythm in many phenomena, one of which is the revolution of the moon, another ebb and flood.

* Lowthian Green, *Vestiges of the Molten Globe*, London, 1875, and Honolulu, 1875.

It is not only the sea which ebbs and flows but also the so-called dry land, the fluctuation of whose surface in connection with the moon's rhythm, has a magnitude of plus or minus 23 cm.*

It has been discovered that the rhythms of the sun and moon synchronize to a measurable extent with the deformations of the solid ground of the earth.†

The earth has pulsations. The earth is actually alive. A long time ago we advanced beyond the conception of stable continents which never alter their position. That idea has been destroyed by Alfred Wegener.‡ The distance between Europe and America increases yearly by about one metre, Iceland moves away from Norway at the rate of about 9 to 18 metres a year, Greenland from Scotland about 18 to 32 metres, Madagascar from Africa, about 9 metres. Although further observations may show variance in these figures,§ one thing is certain, namely that the earth is not a rigid body, and that the changing conditions are not only due to and subject to the great geological epochs, since the earth in itself has movement and moves.

Wegener has pointed out that the continents change their relation to one another. Kreichgauer has proved that the crust of the earth glides over the nucleus. R. Hoernes|| has explained the ideas which have been evolved concerning the movements of the earth-axis.

Nothing is left of the old conception of a globe spinning eternally upon its never-changing axis.

The rhythmic rise and fall of the waters of the sea varies considerably according to locality. It has been

* Rudolf Tomaschek in *Das Weltall*, Treptower Sternwarte 32, Jahrgang. Heft 4–5 Berlin, January 1932.

† Rebeur Paschwitz, *Astronomische Nachrichten*, 1892, vol. cxxx. O. Hecker, *Beobachtungen an Horizontalpendeln ueber Deformation des Erdkoerpers unter dem Einfluss von Sonne und Mond*, Berlin, 1907. W. Schweydar, *Theorie der Deformation der Erde durch Flutkraefte*, Berlin, 1916. R. A. Daly, *The Earth's Crust and its Stability*, *Am. Journ. of Science*, vol. 205, 1923.

‡ Alfred Wegener, *Die Entstehung der Continente und Oceane*, Braunschweig, 1922.

§ Wegener, *Die Physik der Erde*, Leipzig, 1934.

|| R. Hoernes, "Aeltere und neuere Ansichten ueber die Verlegung der Erdachse," *Mitteilungen der Geologischen Gesellschaft Wien I*, Seite 159–202.

found in speaking of the ebb and flood of tides, that the duration of the flood—that is the time between the lowest level and the touching of the high-water mark—does not amount to exactly six hours, but from day to day is prolonged by about forty minutes. It is also true that every fourteen days the water reaches a maximum height, and that eight days before and after such a maximum, a minimum is reached. Since it becomes clear in consequence that the duration of the tides corresponds to the upper and lower culmination of the moon, and that full moon and new moon also exercise a strong influence on the tides, it was natural that comparisons should be made between the rhythm of the moon and the rhythm of the tides. Ebb and flood are already mentioned by Herodotus;* Strabo mentions the connection with the moon;† Caesar speaks of the connection of floods with the phases of the moon,‡ and Pliny ascribes an influence on the tides not only to the moon, but also to the sun.§

Newton explained the tides as the effect of the difference in degree of the gravitation of sun and moon, whose attraction on that side of the earth which either faces or is turned away from them, causes the movement of the waters. More modern scientists take into account the influence of other planets as well as meteorological factors and coast formation.

In his *Harmonious Analysis*, published in 1868, Lord Kelvin invented an instrument by means of which it is possible to ascertain which various single factors at a given point on the coast produce the complicated results of their combined action.‖

G. H. Darwin¶ and Boergen** have developed the theory further. With the aid of Lord Kelvin's harmonious constant it is now possible to calculate the flow of the tides in advance, and thus give advance information to

* *Herodotus*, vol. ii, chap. 2.
† *Strabo*, vol. iii, chap. 5, p. 173 Cas.
‡ *Bellum Gallicum*, vol. iv, p. 29.
§ *Plinius, his. nat.*, vol. ii, chap. 97–9.
‖ Report of the British Association for the Advancement of Science.
¶ *Ebbe und Flut*, Leipzig, 1902. ** *Ann. der Hydrographie*, 1885.

the navigator, since he has invented an apparatus which automatically registers this complicated calculation.* Three of these tidal predictors are in the possession of the Governments of Great Britain (Science Museum, London), France, and British India.

The harmonious analysis calculates the real phenomena by replacing the real moon and the real sun by several hypothetical celestial bodies which, under more simple conditions than those prevailing in the real celestial bodies, could by combined action produce the actual phenomenon. For example, one of these moons is supposed to be always moving round the earth within the plane of the Equator, maintaining the same speed and the same distance all the time. We find that by such assumptions as this we can be furnished in advance with quantitive entities by which we are enabled to know of the phenomenon even before it occurs.

However, such descriptions bring us no nearer to a real understanding of the matter. He who perceives the phenomenon and experiences the life stream in this rhythmic interaction is nearer to reality, and this reality consists in the fact that the earth, like every living being, lives rhythmically. No mathematical calculation can explain life, since its innate laws defy exact calculation. That which can be calculated must, at some time, come to a standstill, because the assumption of finite precision leads to a dynamic system which will ultimately stop of its own accord. Life cannot be calculated. Nevertheless calculation is necessary for practical purposes; apart from practice it has absolutely no theoretical value. The actual tides show extraordinarily varied phenomena. In some places there are four tides within a moon day, as for instance, at Poole and Weymouth in Dorsetshire; while in other places there is only one tide, as on the coast of Tonkin, on the North and South coasts of New Holland, at Pertropaulowsk, and on the coast of the island of Juan Fernandez. Again, there are other places where there is practically no visible movement which could be connected with the moon. The height of the

* Compare "Robots" in *Nature*, 1879, vol. xx, p. 281.

tides, too, varies considerably. In some bays, as in the bay of St. Michel, the tide rises to an exceptional height owing to the waters gaining in height what it loses in width. The rotation of the earth, too, influences these phenomena, and causes, for example, higher tides on the French coast of the English Channel than on the English coast.

Alexander Supan states in his fundamental outlines of physical geography: "To-day scientific research with regard to the oceans is still far from being able to give us a satisfactory analysis of the phenomenon of tides. Real progress cannot be expected until we are able to study the tides on the open, deep ocean, where they could be observed in their greatest possible simplicity, or at any rate least subjected to terrestrial influences. For this, however, the necessary technical means are as yet lacking."*

There is no doubt that the phenomenon of ebb and flood is a very complex one, in which the most manifold forces are at work, namely, the half-daily tides which correspond to the movements of moon and sun, the daily tides, the half-monthly, the monthly, and the yearly tides; the coast formations, the inner friction, the depth of the ocean, and meteorological influences. These are approximately the main factors. But they are all more or less of a mechanical nature, and obviously can only represent that realm in which a rhythmic living force has its play; a force as independent of the mechanism of its field of action as the quality of tone is independent of the waves in the air which carry it. It would be misguided to neglect the one for the other, and it would be equally wrong to identify the inner meaning of the living rhythm of the ocean with the complicated combination of mechanical phenomena within which it manifests itself. It transcends these mechanical forces and is something fundamentally different. It is that same harmonic analysis which shows us that quite different mechanical laws, as, for instance, a number of hypothetical moons

* Alexander Supan, *Fundamental Outlines of Physical Geography*, 7th edition, Leipzig, Berlin, 1927, p. 312.

and suns, can have one and the same mechanical effect.

Now let us try to fathom the qualitative inner being of ebb and flood. To approach this problem we must study cosmic influences which, though of no great quantitative importance, bring us nearer to its inner meaning. As the tide-creating force—to use the scientific terms of gravity—depends on the third power of the distance of the tide-creating heavenly bodies—namely the sun or moon—so every change in the distance between sun or moon from the earth must change the phenomena of the tide. The distance between the sun and the earth varies from 22,949 terrestrial globe radii on January 2nd to 23,731 globe radii on July 2nd. These days of nearest proximity and greatest distance between the sun and the earth are movable and interchange their position in 10,400 years. In the half-yearly period between the nearest proximity and greatest distance of the sun (Aphelion and Perihelion) there is an increase in the tide-creating force of 100 : 110·6 is observed, however, for the height of the sun flood tides varies from 234 to 259 mm. In the case of the moon, which moves in a much more easily defined ellipse, the distance from the earth varies between 57·03 and 63·66 radii of the globe of the earth, and accordingly the level of the moon flood-tides vary from 455 mm. in Apogaeum (the point on the course of the moon furthest from the earth) to 632 mm. in Perigaeum (the point nearest the earth). This amounts to an increase of 100 : 139, a very much more pronounced increase than that of the sun floods. It is these variable influences, therefore, which alter the whole phenomenon of the tides in the course of very long periods of time. The divergence is thus called parallactic or elliptic, because it is the elliptic course of the heavenly body which, through its changing distances, causes the changes in the phenomenon of the tides. In as far as the influence of the moon is responsible for the indicated rhythm, it extends over a period of 18·6 years, after which the same conditions are repeated; but those rhythms which depend on the sun do not repeat themselves until

21,000 years have elapsed, when the Perihelion falls again on the same day in the year. Since the number of flood tides during one year amounts to about 705, roughly 15 million flood curves must pass before the same forms recur. In addition, the interfering influence exercised by the interdependent attraction between the three bodies of the sun, moon, and earth, must be taken into consideration, and it must also be remembered that the velocity of the moon's circuit is not constant. In certain positions the sun draws the moon away from the earth, while in others sun and earth draw the moon nearer to the earth, which again influences the position of the moon by 1 degree and 15 min. A further divergence of 0 deg. 39 min. is due to the well-known so-called "variation." The difference resulting from all these causes in the total distance of the moon is only one-sixth whereas the difference in time in the moon's circuit amounts to: 1 deg. 15 min. plus 0 deg. 39 min.= 1 deg. 54 min. or 7 to 8 minutes of time.

The great cosmic periods can thus be seen at work in the phenomenon of the tides. They are under the influence not only of the day, the month, and the year, but of the cosmic rhythms as measured by the platonic world year of 25,920 years, called by modern astronomy "precession." Precession is a movement of the sun in the opposite direction of its yearly course which is due to the fact that within the course of a year it does not quite reach its starting-point, but remains a little behind the preceding year. In 25,920 years, this amounts to a complete circuit but running in the opposite direction of the yearly circuit. And again, the connecting line between the points of extreme proximity or distance of the sun and earth, executes a circuitous movement four times as long as measured by the circuit of the Platonic year. (Movement of the apsidal line).

The number 25,920 is not an accidental one. We draw 18 breaths a minute,* 1,080 in an hour, and 25,920 in a

* Compare Gotthilf Heinrich Schubert, *Die Geschichte der Seele* (history of the soul), vol. i, 1878, Cotta, Stuttgart, p. 116: "if one reckons an average of 18 breaths a minute (for the normal adult there is one breath to every

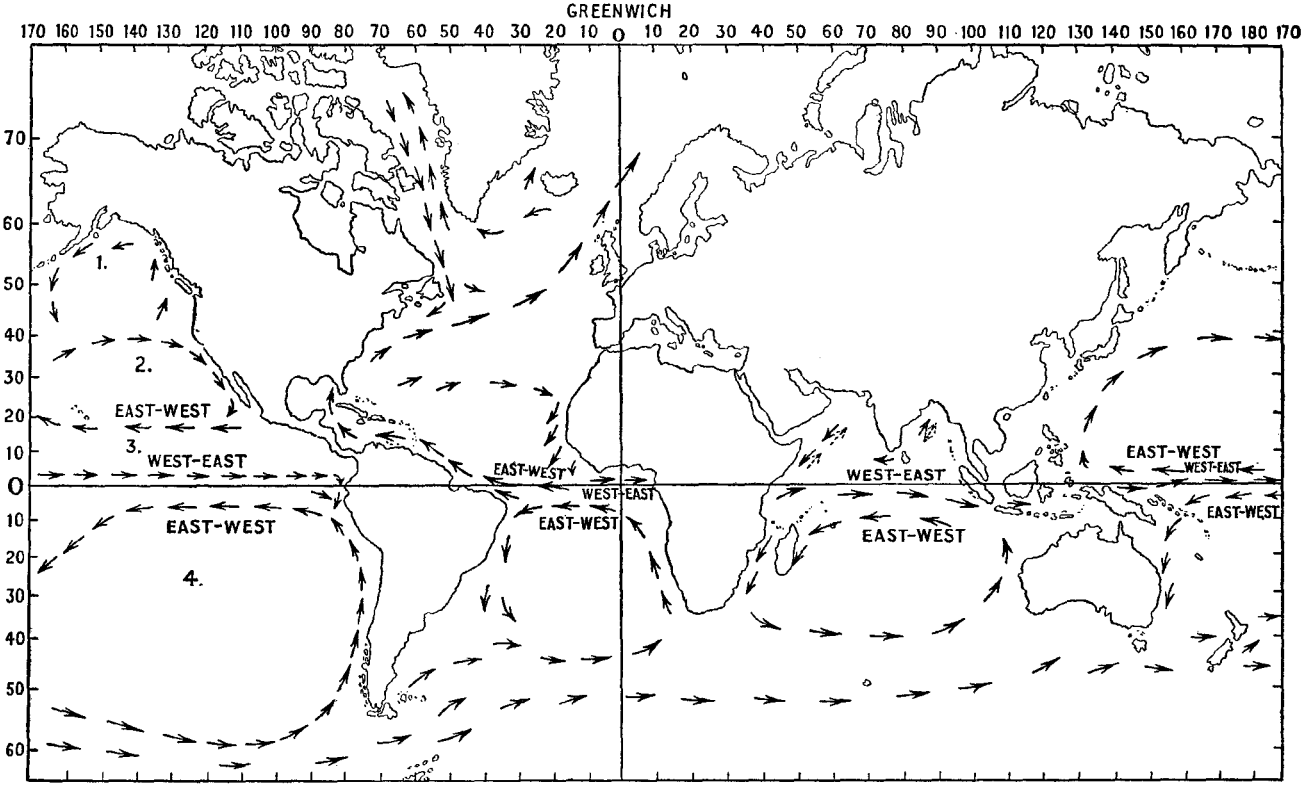
day, and we have four times as many pulse beats. This is to say that what it takes the universe 25,920 years to perform, man, who in every respect is a microcosm, does in one day. The world-year is compressed into one day; and what we experience in the interplay of pulse beats and breathing, the universe experiences in the relation between the precession and apsidal movement. Ordered within these phenomena is that of the tides. In the cosmic sense it is true that the ocean breathes. That which a naïve consciousness experiences spontaneously, the reasoning intellect grasps last, but it must take into account all aspects and not quantitative values only.

In the same way that breathing and blood pulsation play very intimately into the upbuilding and dying processes of the senses of the human organism, so ebb and flood regulates itself in the organism of the earth. The earth is a living being which experiences in the course of thousands of years what is condensed into one day for the individual man. Our actions should be guided by a sense of responsibility arising from the knowledge that we shall be called to account by the millennia.

In addition to those phenomena of the tides which have a definitely rhythmic character and are interwoven into the larger and smaller cosmic rhythms, there are currents in the oceans which, working in continuity, create a very effective circulation through the whole watery masses of the oceans. Here they drive the polar water to the equator, there the waters of the tropics to the arctic and antarctic seas, now warm, now cold, thus enabling us to compare the currents to a system of arteries and veins within the moving depths of the ocean.* If we were to sketch these currents, showing their course north and south of the equator in each of the great oceans, we would obtain a picture something like this.

four pulse beats) the number of breaths in a day is 25,920. The $365\frac{1}{4}$ part of 25,920 years—the great so-called platonic year—(the period of the advance of the equinoxes) is 72/3 years, that is the average duration of man's life. We breathe, therefore, 25,920 times 25,920 times in a lifetime."

* Mauzy, *Physical Geography of the Sea*, London, 1874.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EAST-WEST

Here we have two east-west equatorial currents, and between them a west-east equatorial counter current. North and south of the equator the currents would circulate in opposite directions, making altogether six; so that to each circulation in the northern side there would be a corresponding one on the southern side of the equator.

(1) Circuitous stream between 50 deg. lat. and the pole.
(2) Circuitous stream between 50 deg. lat. and 10 deg. lat.
(3) Circuitous stream between 10 deg. lat. and 0 deg. lat.
and (4), (5), (6) correspondingly in the south.*

All these currents remain on the surface of the oceans, and it is clear that there are others in the depths. Long ago it was discovered that the winds are one of the principal forces of these currents. K. Zoeppritz† has investigated the connection between wind and sea currents. He says: "It is not only the surface which lies open to the wind which is being shifted, but the lower parts as well, in decreasing velocity, owing to the inner or molecular friction in the water. Provided that the wind continues sufficiently long in the same direction, no depth limit can be set to the current; but it would require a duration of the length of 239 years to bring half of the surface velocity to a depth of a hundred metres. In other words: the great sea currents of to-day are the results of all the winds that have swept for countless thousands of years over these parts of the ocean."

These oceanic streams, in as far as they have been caused by the winds represent thus a kind of record in the earth's memory which preserves the fleeting formations of the wind. The drawing of the stream into the depths cannot however be understood as a mere deepening of the current, for as the stream progresses in its downward movement to lower and lower levels, the rotation of the earth brings about a turning of the current. Thus in the case of the equatorial at a depth of about 110–165 yards, the velocity has been reduced

* Otto Kruemmel, *Handbuch der Ozeanographie*, Stuttgart, 1923.
† K. Zoeppritz, "Zur Theorie der Meerestroemungen," *Annalen der Physik*, 1878, vol. iii.

to one-twentieth, and the direction of the stream has turned 180 degrees, so that the current in the depth has turned completely round, and is flowing in the opposite direction. Nor does the water take by any means the same direction as the wind, but deviates at an angle of 45 degrees on the surface; and half-way down between the surface and the lower level, where the flow has taken the opposite direction, it deviates at an angle of about 90 degrees.*

The process of transmission from air-to-water movement must, therefore, be imagined as a spiral one, with a right-turn in the northern and a left-turn in the southern hemispheres. The wind "screws" itself into the sea.

Wherever the wind blows the water away, the pockets thus formed are filled up by other waters, and streams of a very complicated and independent nature arise which are known as "compensation" streams. The "filling up" water can also rise from the depths, as for example on the west coasts of North and South America and Africa.† Other currents may be due to the varying salt-content of the seas and the consequent differences in degree of liquidity. The surface stream flows from the point of lesser density to the point of greater density, and the corresponding lower stream vice versa. Between the two levels lies another, not always horizontal, level.

From the Atlantic a surface stream flows into the Mediterranean, because the latter contains more salt than the Atlantic. The heavier, more salty waters of the Mediterranean sink down, and, under the influence of these heavily pressing salty pillars of water, push along the bottom towards the Atlantic, while the lighter waters of the Atlantic swim on top and flow into the Mediterranean.‡

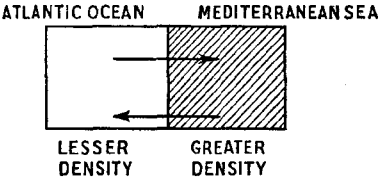
In the same way the waters of the Black Sea, which contain but little salt—a fact first recognized by Aris-

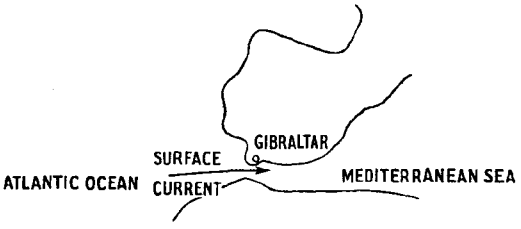
* W. Ekman, "Theorie der Meeresstroemungen," *Annalen der Hydrographie*, 1906, p. 426 ff.

† Alexander Supan, *Grundzuege der Physischen Erdkunde*, 7th edition, 1927, Leipzig, Berlin, vol. i, p. 320 (Karte der Auftriebwasser an den Kuesten).

‡ Carl Forch, *Annalen der Hydrographie*, 1909, p. 442, and 1906, p. 118.

totle—flow in a surface stream through the Bosphorus and the Dardanelles into the Mediterranean. The waters of the Baltic, also poor in salt, flow over the surface through the Belts and Kattegat into the North Sea. These examples show that it is the difference in density also which causes sea currents, which fact has already been commented upon by Leonardo da Vinci. The salt content of the oceans has an average of 35 promil. Strong evaporation or freezing increase the content; the influx





of rivers, abundant rain, and the melting of ice decrease it. Where the humidity of the air is exceptionally low, and continents radiate warmth, the oceans show a high degree of evaporation, and attain the highest proportions of salt content, as in the Red Sea, the Mediterranean, and the Persian Gulf. The zones which contain the most salt are found in the northern hemisphere between 25 and 30 degrees, and in the southern hemisphere between 20 and 25 degrees. These are the so-called "horse latitudes," where the monsoons originate. A great dryness in the air and lack of cloud prevail; in consequence there is little rain.* Abundance or scarcity of salt and

* Otto Kruemmel, *Handbuch der Ozeanographie*, Stuttgart, 1923, vol. i, p. 367.

the ocean-streams which result from them, are therefore due to the division of the earth into zones. But even in this realm we do not find eternally stable order; on the contrary, to obtain a true picture of their reality, we must imagine everything in a continual flow. Thus a continuous period of east winds, especially in the spring, reduces the salt content in the surface waters of the Belts up to 10 promil, while strong westerly winds cause an increase up to 20 to 22, or even up to 30 promil,* into the Kattegat.

The salt-content does not, however, merely regulate part of the sea currents, but also plays an important part in the conditions required for the propagation of the fishes, whose floating eggs would sink into the depths if the proportion of salt were not correct. The Baltic codfish, for example, has spermatozoans which show a high vitality in the western parts of the Baltic at 15 promil salt-content, while east of Bornholm they only live in considerably greater depths, where there is the same content of salt. In the top level, where the salt-content is 7 to 8 promil, they become rigid. Where the percentage of salt sinks below 10, in the greater depths also, fish-eggs—and not only those of the cod—become scarcer, sinking down and often perishing in the slime. Around the Finnish cliffs it is only in certain years that the salt-content is sufficient for a codfish to be able to thrive. Flounders live in waters of lesser salt-content in eastern and central parts of the Baltic, and for spawning they seek ground with higher proportions of salt, as for example, in Bornholm Bay on the coast of Ruegen, or in the Bay of Danzig. During spawning time these waters swarm with fishes, whilst in summer and autumn they are entirely deserted.†

The oceanic streams provide room for the existence of many other living forms. In the middle part of the North Atlantic sub-tropical circuitous stream, within

* Otto Kruemmel, *Handbuch der Ozeanographie*, Stuttgart, 1923, vol. i, p. 330.

† S. Stordtmann, *Laichen und Wandern der Ostsseefische in Wissenschaftlichen Meeresuntersuchungen Abt.*, Helgoland Bd. 7, Heft 2, Kiel 1906.

which lies the Sargasso Sea—so called after the drifting bundles of the Sargasso seaweed—we find the spawning-ground of the European and American river-eel.*

In considering this interdependence of physical, meteorological, geographical, and biological facts, all of which are so ordered that, in the end, they re-shape the fate of the earth—we come to realize that all that happens is directed by physical and mechanical laws, these representing an instrument used by the planet to produce a harmonious and well-ordered totality of life, where man can find a means of developing his aims, and enabling him to carry out these aims with purpose and ingenuity. No less a man than Kepler has given expression to these ideas, and he should be held in esteem, not only on account of his three laws, which give a mechanical picture of the world, but also for his *Harmonia Mundi*, in which he describes the earth as a living and even as an ensouled being. We must re-discover this conception. The latest findings of natural science do not refute it; on the contrary, they all point in this direction. And for his economic life man needs just a revised picture of nature. Only by feeling himself to be a collaborator in a well-ordered planet in whose working he can see aim and purpose will he be able to find the way to fruitful work in real freedom and under his own full responsibility.

* Joh. Schmidt, *Internationale Revue der Hydrobiologie*, vol. ii, 1923.

Chapter VI

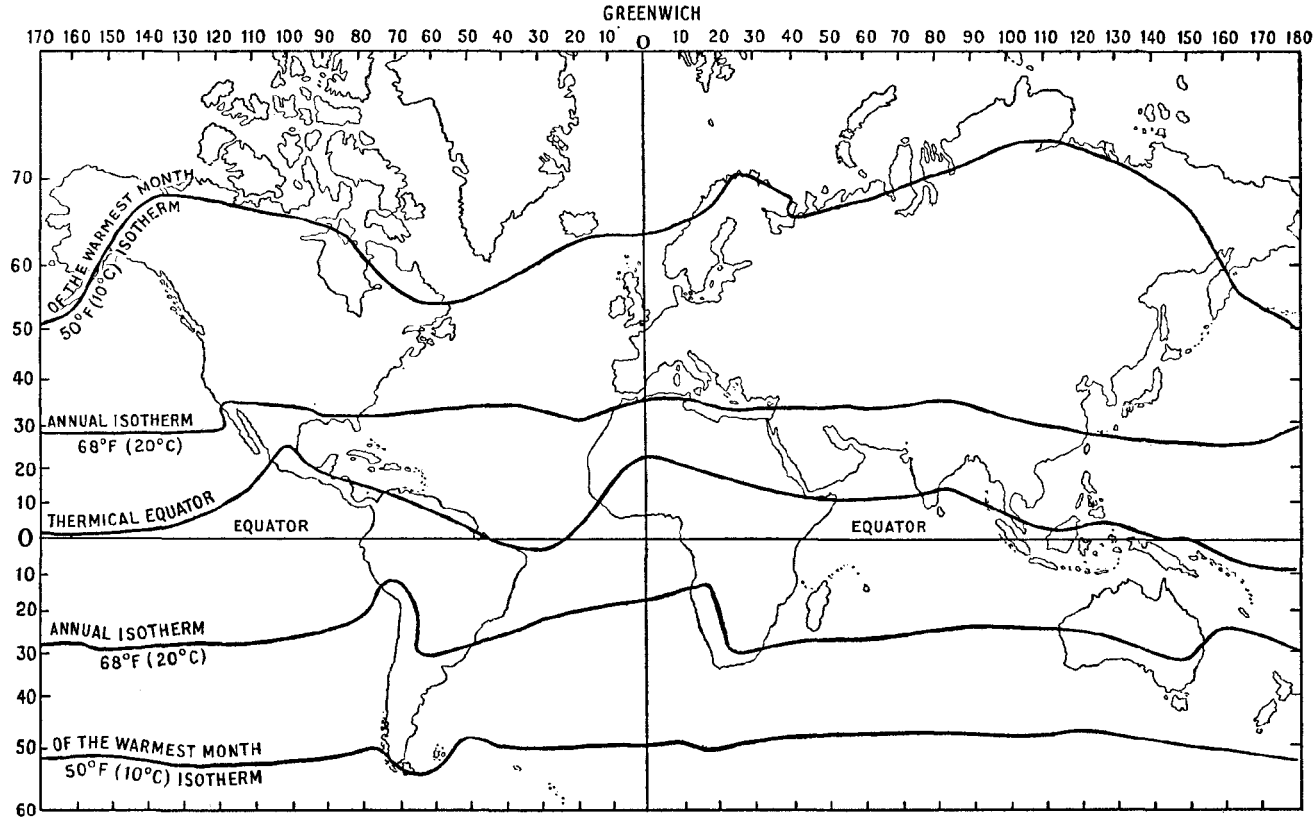
The Air and the Temperature System of the Earth

THE distribution of warmth over the surface of the earth is, generally speaking, divided into zones. But the zone with the highest temperatures, the thermic-equator, does not coincide with the geographical equator, the largest of the parallel circles. The expanse of dry land exceeds that of the oceans in the northern hemisphere, while in the southern hemisphere the oceans predominate, with the result that the region of greatest heat lies about 10° north of the equator with a temperature of about 0·9° F. (0·5 Celsius) higher than that of the equator. Only in January is the equator the hottest parallel belt, while in July the hottest belt lies a little north of 20°. The thermic equator lies on the northern hemisphere during the whole year. The southern hemisphere is, on the whole, about 2·7° F. (1½ Celsius) cooler than the northern one. Both the dry land and the oceans are warmer in the northern hemisphere. Furthermore warm streams from the south cross over to the northern hemisphere into which the south-east monsoons drive the warmer waters from the southern hemisphere.*

January and July always occupy a special place in all temperature-analyses of the earth, because January constitutes the middle of winter in the northern, and the middle of summer in the southern hemisphere.

The Ancients had already divided the earth into climates (derived from *klinein* = incline) according to the degree of the slanting of the rays of the sun. This resulted in a division into zones corresponding to geographical latitudes and to the duration of the day, or of the dura-

* Julius Hann and Reinhard Suering, *Lehrbuch der Meteorologie*, Leipzig, 1926, p. 143 ff; Woeikof, "Ueber der Einfluss von Land und Meer auf die Luftemperatur," *Meteorologische Zeitschrift*, 1888, p. 18.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50°F (10°C) ISOTHERM

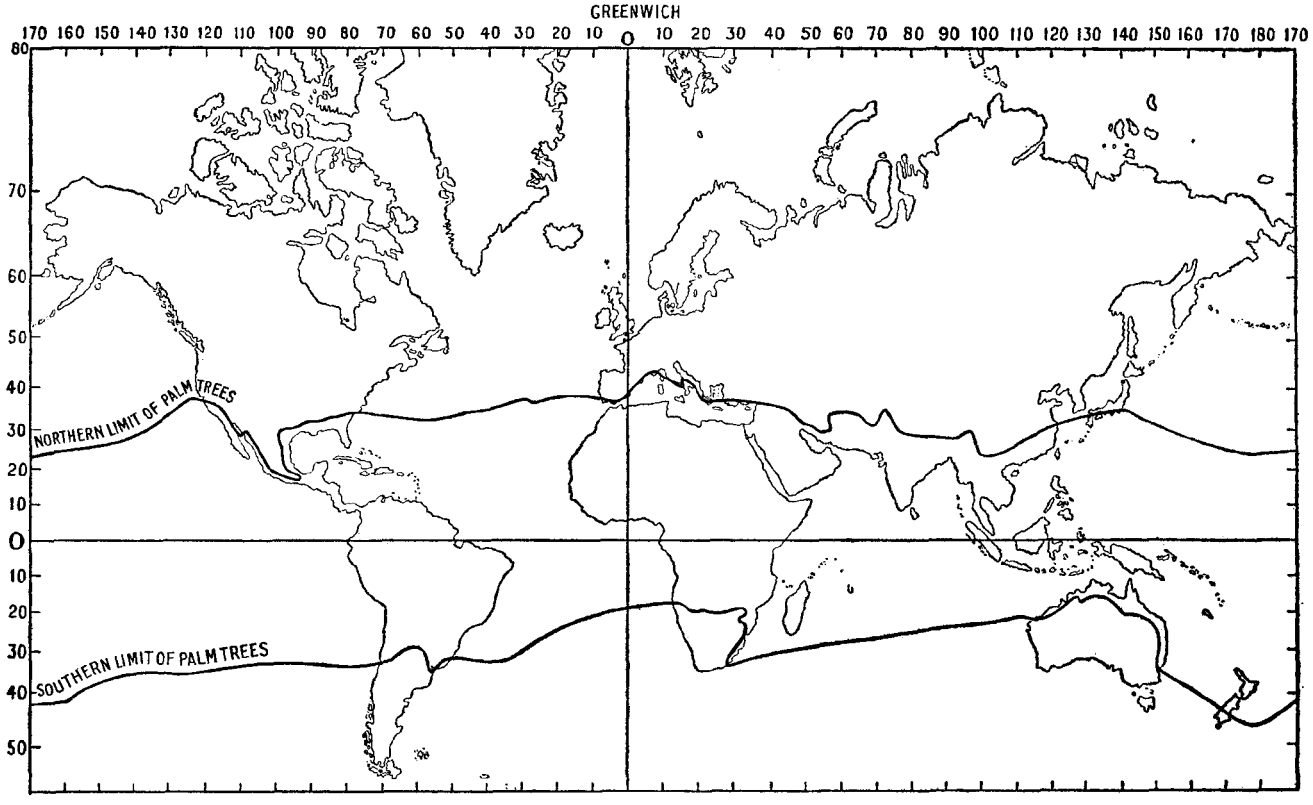
tion of the influx of the rays of the sun. As regards the geographical latitude, the increase in temperature is in proportion to the square of the cosine of the degree of latitude, so it has been made possible thus to deduce the temperature of a given latitude from the cosinus of the latitude multiplied by the temperature of the equator. The temperature resulting exclusively from these factors is different from the actual climate, and attempts have been made in consequence to modify the division of the earth into zones. This division can be guided by the equator, the tropics and the polar circles, but only roughly as has been indicated already by the shifting of the thermal equator into the northern hemisphere. Alexander Supan has introduced isotherms as the borderlines between climatic zones in the place of parallel circles. The idea of the isotherm can be traced back to Alexander v. Humboldt. They are the connecting lines of those points on the map which have the same temperature during a certain part of the year, or during the whole year. It was in 1817 that Humboldt first drew a map showing the isotherms on the temperature for the year, and in 1848 Dove did the same for the month. As the temperature depends on the level of the oceans, the figures given on the isothermic-maps are those reduced to the temperatures which prevail at sea-level.

The annual isotherms of 68° F. (20° C.) are approximately at either the polar or the palmtree boundaries which trees being characteristic of the tropics, are taken as the boundaries of the warm zone.* They indicate at the same time the extent of the monsoons towards the polar regions, since the monsoons too are characteristic of the earth's warmer regions.

The 50° F. (10° C.) isotherms of the hottest month generally constitutes the northern boundary for the growth of trees and corn (with the exception of Tierra del Fuego) and can be taken as the boundary of the temperate zone towards the polar regions. W. Koeppen†

* Alexander Supan.

† W. Koeppen, "Die Waermezonen der Erde," *Meteorologische Zeitschrift*, 1884.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NORTHERN LIMIT OF PALM TREES
SOUTHERN LIMIT OF PALM TREES

has suggested a different division by taking also into consideration the duration of the warm periods:

(1)	Tropical belt:	12 months hot, above 20° C. (68° F.).
(2)	Subtropical belt:	4–11 months hot, above 20° C. (68° F.). 1–8 months temperate, 10° to 20° C. (50° to 68° F.).
(3)	Moderate belt:	4–12 months temperate, 10° to 20° C. (50° to 68° F.).
(4)	Cold belt:	1–4 months temperate, 10° to 20° C. (50° to 68° F.). 8–11 months cold, below 10° C. (50° F.).
(5)	Polar belt:	12 months cold, below 10° C. (50° F.).

The temperate belt is again subdivided as follows:

(*a*) Constantly temperate (only on the oceans).
(*b*) Summer hot (only on the continents).
(*c*) Temperate summer and cold winter (spread around the whole belt with the exception of Siberia).

This division, which takes into account the duration of prevailing temperatures, should prove to be of some importance in plant-geography.

Koeppen has consequently followed up this aspect in particular, giving special consideration to the trees.* The climate of 50° F. (10° C.) over a period of four months appertains to the oak, while a climate with only one month of this temperature belongs to the birch tree.†

We are indebted to Heinrich Engelbrecht for an investigation which principally concerns the various kinds of corn. The statistical methods employed in this work are of great importance, but are unfortunately out of date, and should be taken up to-day by some Institute for research in a world-embracing investigation in relation to modern conditions.‡

* W. Koeppen, "Versuch einer Klassifikation der Klimate, vorzugsweise nach ihrer Beziehung zur Pflanzenwelt," *Geographische Zeitschrift*, vi, 1901, p. 34. Also Konrad Rubner, *Klima und Holzverbreitung in Europa, in Forschungen und Fortschritte* (Jahrg. No. 27), September, 1933.

† W. Koeppen, *Die Klimate der Erde*, Leipzig, 1923, p. 160.

‡ *Die Landbauzonen der aussertropischen Laender*, 1899, Berlin. *Die Landzonen der Erde in Petermanns Mitteilungen, Ergaenzungsband*, 1930, p. 281. *Die Feldfruechte Indiens in ihrer geographischen Verbreitung, Abhandlungen des Hamburger Kolonial institutes*, vol. xiv, 1914, Hamburg.

Engelbrecht deals with all kinds of corn and vegetables, showing their geographical distribution and giving statistics of their relative quantities. Thus he weaves into his work on plant geography a certain amount of folk psychology, by showing how one kind of grain gives way to another or predominates over it, according to the cultural habits of the inhabitants of the land. The interesting maps he has compiled prove that these groups of population by no means coincide with the national state frontiers, but that on the contrary, economic life follows its own laws, quite independently of national borders. For example, where the natives of Africa grow sorghum the white man grows maize, and one can see quite clearly how one plant gives place to the other. This shows that the climate provides only the possibilities, while man with his activity enters into, and changes all the conditions.

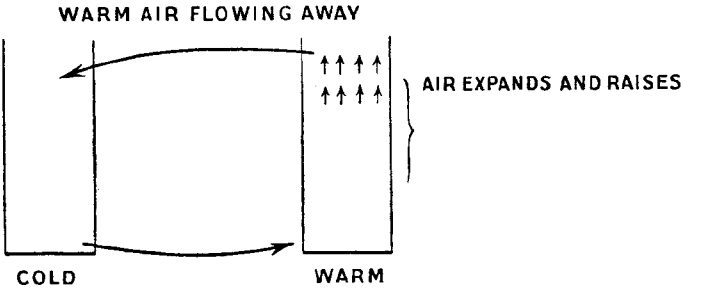
From whatever point of view we distinguish the climatic belts, the earth must always appear to be divided into zones. These zones have a considerable influence on the distribution of temperature, air pressure, and wind. They also influence open currents, rainfall distribution, and, ultimately, the distribution of life itself.

If for each of these zones we were to draw a special map, and if these maps were to be compared one with the other, their interconnection would at once be apparent. If, however, the maps were placed one on top of each other, we should find that they would not exactly correspond. The points that should correspond would be slightly displaced, and from this irregularity it is to be concluded that these phenomena are not governed by mechanical laws alone.

Over the belt of the highest temperature, which we call the thermic equator, the heated air rises and then streams either north or south. In these parts the air pressure is low in consequence. These air currents do not reach the poles, but drop down much sooner, namely in the so-called "horse" latitudes, which owe their name to the fact that when the seafarers with their shipments

of horses were becalmed in these regions, they were obliged to throw the horses overboard owing to lack of fodder.*

Maury called this region the calms of the tropics. Hans Suering† says "between the horse latitudes and the equator there is a closed atmospheric circuit, such as would exist between the equator and the poles but for the rotation of the earth." But the belts of high pressure in the horse latitudes (caused by the descending heavy air) form a kind of parting-line of wind. From there the monsoons go over the surface of the earth



towards the equator, and the westerly winds of the high latitudes towards the poles. Owing to the rotation of the earth all winds coming from the poles towards the equator move at a velocity which is necessarily less than that at equatorial points, because they come from latitudes in which the movement of each point on the surface of the earth is slower than that on the equator. This lagging behind against the west-east movement of the earth gives the impression that these masses of air are moving in the opposite direction, that is, east-west. These winds with a component east to west, are the monsoons. We are already acquainted with the equatorial sea currents which are caused by them.

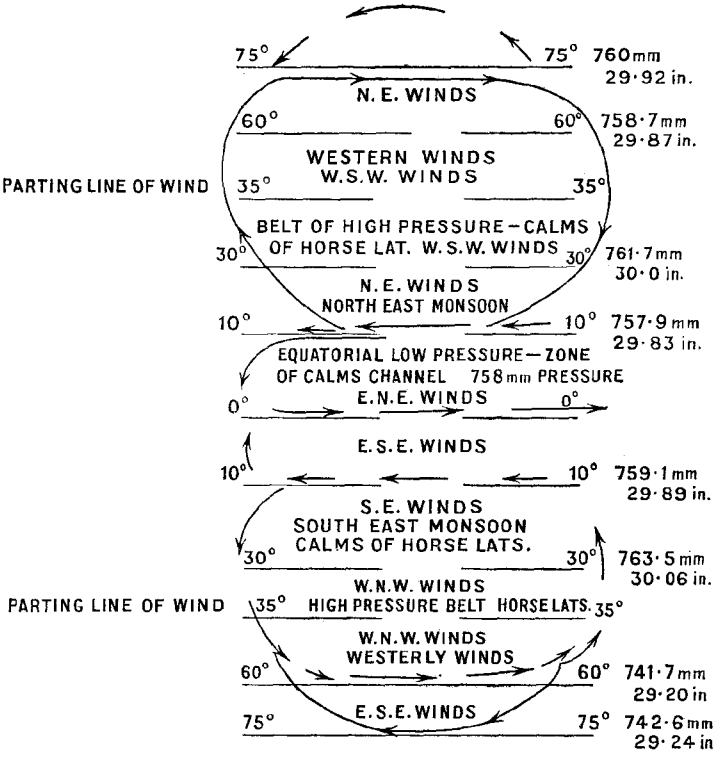
Thus, the winds are formed by the interaction of the rotation of the earth with the difference of temperatures

* Gustav Adolph von Kloeden, *Handbuch des physischen Geographie*, vol. ii, p. 514, Berlin, 1859.

† Hans Suering, *Lehrbuch der Meteorologie*, p. 503.

between the cold poles and the hot equator. The relation of the wind to the temperature is being regulated by the air pressure. From the difference of temperature,

THE TABLE SHOWS HOW THE ZONAL DIVISION OF THE EARTH (ACCORDING TO TEMPERATURE) PRESSURE, WINDS AND CURRENTS OF THE SEA ARE CONNECTED ONE WITH THE OTHER.



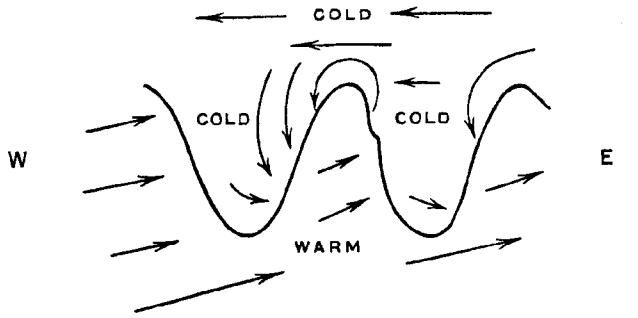
THE ARROWS SHOW THE SEA CURRENTS AND THEIR RELATION TO THE DISTRIBUTION OF PRESSURE AND WIND.

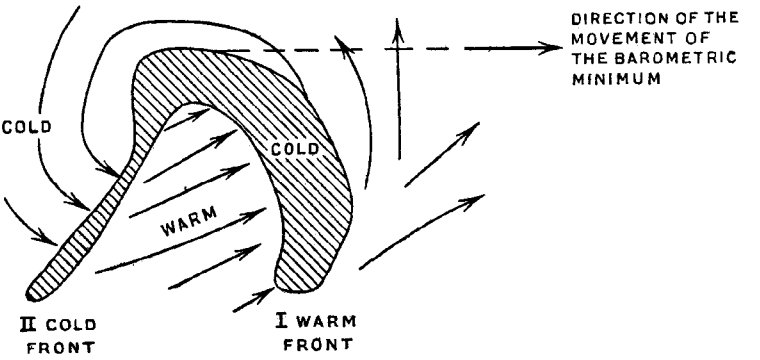
differences in air pressure arise, for the adjustment of which the air masses are set into motion and become manifest as winds.

The rotation of the earth works into this play of forces and effects deviations. But these laws do not yet explain actual conditions; they only explain the

winds, which imprint themselves into the sea currents, and the corresponding adjustment in the pressure of the air.

The polar region is covered by a cap of cold air, which flattens out in the shape of a wedge, towards the





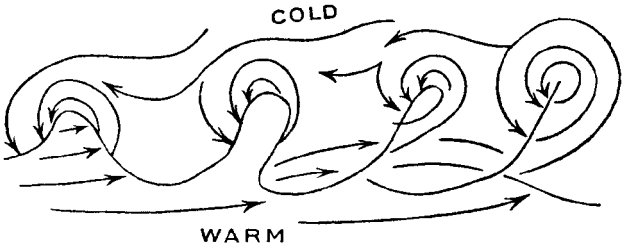
boundary of the Arctic.* The dividing line between the cold, and the warm air, forms the polar front. This is a complicated plane between the warm air moving west-east, and the cold air moving east-west. The warm and the cold air which collide on this plane form whirlwinds in which the two fight one another. Here the moving barometric minima (cyclones) originate which extend along the polar front in wedge-shaped formations.

* Bjerknes.

The cold air catches the warm air in an enfolding spiral, the warm section of the depression becoming narrow through the expansion of the cold air in the space.

Four cyclones moving from the equator towards the passat zone show us four stages of this process and illustrate how in the end the two cold fronts coincide.

The warm air is being cut off from its connection with the reservoir of warm air and is overpowered. In this process we see the dying down of the cyclones. Cyclones are whirlwinds, which in the northern hemisphere move in an anti-clockwise direction around a low pressure sphere, and in the opposite direction in



the southern hemisphere. These enclosing and unfolding spirals are really to be regarded as the primal forces in the production of weather conditions, and the oceanic streams also follow their forms.

In dealing with sea currents, it is necessary to reckon not only with a circulating movement, but with complicated revolving spiral movements, as well, and the same applies here. The earth's rotation is obviously only the expression, and not the cause of the spiral formations. We must depart from the principle of mere mechanical explanations, for the phenomena are far too obviously parts of a wonderful, and well ordered whole, to allow us to imagine that chance, with a few mechanical laws, should have set it all going. The spiral tendency is apparent in the star nebula, and is to be seen in our planetary system which, as we know, does not always turn around the sun, but together with the sun—and therefore continues on in its course in a spiral movement.

The same tendency, which Goethe also discovered in the plants, is found to be the first form to manifest itself in meteorology and in cosmology.

While the plastic principle is working in the sap circulation of plants and other living beings, as well as in the currents, we recognize something of a musical character in spiral formations. A fine music is woven over the planet in the weather phenomena.

Kepler is right in interpreting the coursing of the stars in terms of music, experiencing the revolutions in the major key, and the contractions, that is when stars are approaching one another (Perihelion, Aphelion), in the minor key. We are dealing with musical phenomena. Only in so far as these leave their real home, the element of the air and the stars, and are able to imprint themselves into the system, being able to work plastically, do they express themselves in form of circulation. But this is not their inmost being. Their real inner being is music. Let us study this music. A. Defant* has studied the rhythms in which cyclones follow each other.

His description of it is found in an investigation where he endeavours to study the systems of air pressure which move in waves from west to east within the temperate latitudes. For this purpose he did not investigate the changes in the degrees of pressure, but their effect on rainfall, and he compiled a table showing the total amount of daily rainfall in North America, Europe, Japan, the Argentine, and Australia. He then applied the harmonic analysis to the yearly course of rainfall. The result showed that the fluctuations in the rainfall appear as superpositions of four waves moving west-east, of which the wavelengths are aliquot parts of the earth's circumference. For example,

For the northern hermisphere in 45 deg. latitude: 5·7, 8·7, 12·7, 24·5 days

For the southern hemisphere in 35 deg. latitude: 7·2, 12·1, 16·6, 31·2 days

* A. Defant, "Die Veraenderungen in der allgemeinen Zirkulation der Atmosphere in den gemaessigten Breiten der Erde," *Sitzungsberichte der Akademie der Wissenschaften*, Wien, vol. cxxi, 1912, pp. 379–586; *Literatur*: pages 136–7, *Meteorologische Zeitschrift*, 1913.

It was discovered that the wavelengths correspond to $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$ and one part of the earth's circumference. Exner* and Defant have shown in this research work, that these waves are caused by the alternation of continent and ocean and their consequent thermic differences.

If the width of an ocean or continent corresponds approximately to half the wavelength of the vibrations, it is particularly favourable to the creation of a wave. The width of the oceans or continents creating the shortest wave must, therefore, be $\frac{1}{8}$ of the earth's circumference, or 45 latitudes. In the southern latitude we have Australia with 45 latitude degrees, South America with 35 degrees, and the Atlantic ocean with 55 degrees. In the northern hemisphere North America has 50 and the Atlantic 55 degrees of latitude.

We see that on the southern as well as on the northern hemispheres there are continents and oceans, which are able to produce the two short waves of $\frac{1}{3}$ and $\frac{1}{4}$ of the earth's circumference, and these waves can actually be quite distinctly observed in the course of the weather phenomena.

These investigations draw our attention aptly to the fact of their being a "musical" principle underlying the formation of weather conditions. We can say that the earth, through the alteration of land and sea, constitutes a musical instrument, as it were, on which temperature, air pressure, rainfall and wind produce together the earth's grand symphony, the weather.

* F. N. Exner, "Grundzuege einer Theorie der synoptischen Luftdruckaenderungen," *Wiener Sitzungsberichte*, 199, 1907.

Chapter VII

The Sun and Planetary Influences on Weather and Climate as Foundation for Harvests and Prices

WE were able to conceive the weather in terms of music, produced by the instrument of alternating continents and oceans, which in their configuration are understood not only as plastic formations but also as a musical instrument which produces varying waves. Perhaps this conception will some day throw light upon the riddle of the shape of the continents and oceans.

But the question which we must ask ourselves in this chapter is, whether the great musician who plays on this earthly instrument, has a cosmic model. Science in its present state of research, still carefully feeling its way, answers hesitatingly, but nevertheless distinctly, "yes."

Charles Meldrum, Director of the meteorological observatory on the Island of Mauritius, was the first to give general recognition to the periodicity of the cyclones and rainfall in their connection with the sunspot periods.*

This connection has been mentioned previously by Sir William Herschel also, who was the first to show the relationship between the sunspot rhythms, the frequency of the rainfall and the harvest output and prices.†

It has been discovered that the sunspot maxima and minima are related to the cyclones and to the quantity of rainfall, not, however, unconditionally, but according

* Ch. Meldrum, Report British Association, Brighton 1872 and Bradford 1873.

† Sir Wm. Herschel, *The Scientific Papers of Sir William Herschel*, vol. ii, p. 178, published by the Royal Society and the Royal Astronomical Society, London, and *Philosophical Transactions of the Royal Society of London*, 1884, vol. xci, pp. 265–318; also *Berliner Astronomisches Jahrbuch*, 1806 and 1807.

to the geographical position of the point of observation. As regards the summer monsoons in India, it has been ascertained that during the maximum years of sunspots the rainfall is higher than in the minimum years. The winter rainfall in northern India follows the opposite course.*

The fact of the connection being thus established, the character of the relationship depends upon geographical and seasonal modifications. For instance, it has been found that in the central parts of North America and along the coast of Labrador a temperature prevails in the years of extensive sunspots which is lower by several degrees, whilst on the other side of the Atlantic from the Bay of Biscay to Spitzbergen exactly the opposite happens. The minimum-epochs of the sunspots produce cold, and the maximum-epochs warm years.† It is most instructive to see that one and the same cosmic event can produce so different an effect in various parts of the earth. This would seem to be the rule. North Japan has a good rice crop if August is warm. A warm August in Japan may, however, depend on the rising of the air pressure in the south-east of Canada in April.‡

There is a strong interdependence in conditions on the various points on the earth. We are only beginning to reach an understanding of these facts. The greater the difference is between the temperature of the Atlantic Ocean current on its surface, and its temperature at a depth of 200 metres, the better will be the harvest in Norway; even the German wheat and rye crops are influenced by this factor.§

A small percentage of ice around Iceland in the spring corresponds to favourable conditions for corn crops in Western Europe and North Germany.‖

* S. A. Hill, "Variation of Rainfall in Northern India," *Indian Met. Memoirs*, vol. i, No. 6, 1878.

† L. Mecking, *Annalen der Hydrographie*, 1918, p. 1; also F. Baur, *Mitteilungen der Wetter und Sonnenwarte St. Blasien*, Heft 2, 1922.

‡ T. Okada, ref. p. 652, Hans Suering, *Lehrbuch der Meteorologie.*

§ Alexander Supan and Erich Obst, *Grundzuege der physischen Erdkunde*, vol. i, p. 332, Berlin, Leipzig, 1927.

‖ Meinardus, "Schwankungen der nordatlantischen Zirkulation und ihre Folgen," *Annalen der Hydrographie*, 1904, p. 353. *Meteorologische Zeitschrift*, 1905, p. 398.

We see that sunspots or changes in the circulation of the oceans have, like other cosmic events, very different effects on different parts of the earth. If we could understand them in their totality, they would reveal themselves as organic dependences in a living being.

The variation of the sunspots is by no means a primary phenomenon. A number of scientists have shown that the phenomena of the sunspots are related to the planets.

The investigations carried out by the scientists, Kr. Birkeland,* E. W. Brown,† A. Schuster,‡ Franz J. Goeschel,§ Ellsworth Huntingdon,‖ Vladimir B. Schostakowitsch,¶ Inigo Jones,** have made it clear that the period of sunspots is no more than a combination of planetary periods. The planets, therefore, are working behind all the phenomena which are ascribed to the sunspots. Partly directly, partly by way of the sun, the planets modify the course of events. As the sun radiates into space against gravity, and the planetary forces come into operation wherever such radiation against gravity takes place, so the radiation of the sun must needs succumb to the influence of the planets. With regard to direct planetary influences, so far Venus only has been observed. Henry Ludwell Moore†† indicates the connection between the rhythm of crops and economic rhythms in relation to sunspots and Venus rhythms. Every eight years the rays of Venus are particularly bright.

* Kr. Birkeland, "Recherches sur les taches du Soleil et leur origine," *Skriften udvigne af Videnskabssels Kabet I*, Christiania, 1879.

† E. W. Brown, "A possible explanation of the Sunspot Period," *Monthly Notices, Royal Astron. Soc.*, vol. lx, No. 10, 1900, pp. 599–606.

‡ A. Schuster, "The Influence of the Planets on the Formation of Sunspots," *Proceedings Royal Society London*, vol. lxxxv, 1911, pp. 309–23, deals with Merkur, Venus, Mars, Jupiter, Saturn.

§ Franz J. Goeschel, *Planetare Einfluesse auf die Sonne*, Salzburg, 1912, *Planetare Einfluesse auf die Erde*, Salzburg 1912.

‖ Ellsworth Huntingdon, *Earth and Sun; Weather and Sunspots*, Newhaven, 1923, p. 212.

¶ Vladimir B. Schostakowitsch, "Sonnenflecken und Planetenstand," *Meteorologische Zeitschrift*, Berlin, 1928, Vol. 10.

** Inigo Jones in *Nature*, July 31, 1932, dealing with Jupiter, Saturn, Uranus, Neptune.

†† Henry Ludwell Moore, *Economic Cycles, their Law and Causes*, 1914, Generating Economic Cycles, New York, 1923.

She does not, as one might expect, show the whole disc, but only a sickle with a faintly luminous shadow. She is, however, especially close to the earth in this constellation. Five weeks before her lower conjunction Venus can be seen thus and she shines with exceptional brilliance if she is at the same time in close proximity to the earth. The diameter of Venus is then 40 inches and the size of the luminous part 10 inches so that less than a quarter is shining. In this position, she sends more light to the earth owing to its nearer proximity, than when radiating with her full disc.*

All these cosmic and meteorological rhythms have at any rate been studied from an economical aspect, and extensive literature on the subject is available. The already mentioned observations by Sir William Herschel were made after he had read the fundamental work of Adam Smith and his observations on prices. It struck Herschel that these periods, taken purely economically, coincided with those of the sunspots. As the realization of the relationships first came to an astronomer and not to an economist, this fundamental discovery was ignored. The astronomers regarded Herschel's excursions into the economic field with disfavour, considering them to be quite out of place. The unfortunate position between the scientific disciplines, as in so many cases, once again stood in the path of progress. One cannot help smiling when one reads the polemics against Herschel in the Berlin Astronomical Yearbook, and then his cool reply a year later (1806–1807). There is a decided advantage in settling polemic differences in a yearly periodical. It leaves time to develop sufficient phlegm!

The following reflections would seem to contradict Herschel, but Hermann Fritz has refuted these statements† and the recent research corroborates Herschel on all points.

* George Chambers, *A Handbook of Descriptive and Practical Astronomy*, Oxford, 1889.

† Hermann Fritz, *Die Beziehungen der Sonnenflecken zu den magnetischen und meteorologischen Erscheinungen der Erde*, Haarlem, 1878. *Naturkundelige Verhandelingen van de Hollandische Matschappij der Wetenschappen*, vol. iii, Derde Versameling.

Henryk Arctowsky's* investigations are of special importance because the fact dawned upon him that the temperature system of the earth is an organic unit, in which each part is connected with every other part. Sir William Beveridge and Westerguard have investigated the problem economically from many different aspects.†

Eduard Brueckner shows the influence of the fluctuations in the climate on the crops and corn prices. His work on this subject‡ provides the best introduction for these meteorological problems, and it is satisfactory to observe the versatility of his descriptions.

That the influence of the sunspots is indeed a remarkable one is shown by the research work of the zoologists.§

Vladimir B. Schostakowitsch in his excellent book on periodical fluctuations in the phenomena of nature (1931) with references to further literature, has dealt with their influences on economic life in a most thorough fashion.

We have gone a long way. Unfolding the panorama of the earth from its well-defined contours, over the oceans, through the air and the surrounding atmosphere of warmth, we have passed on to the influences of sun and planets, which are woven through the rhythms of the living earth. Here we come upon the influence of the rhythms of nature on economic life. In crops and corn prices we saw how the earth and the cosmos, working into the life-processes of the earth, actively enter into the course of economic development. Our knowledge in this field was admitted to be elementary as yet, because in consequence of the fact that the organization of our educational system tends to specialization, nobody

* Henryk Arctowsky, *Studies on Climate and Crops*, New York, 1910–12.

† Sir William Beveridge, "Weather and Harvest Cycles," *Journal of the Royal Economic Society*, June 1920, March 1920, and December 1921.

‡ Eduard Brueckner, *Klimaschwankungen*, Wien, 1890.

§ H. Simroth, "Der Einfluss der letzten Sonnenfleckenperiode auf die Tierwelt," *Kosmos* 9, 1908. A. W. Anthony, "Periodical emigrations of Mammals," *Journ. Mammal.*, vol. iv, p. 60. R. E. de Lary, *Arrival of Birds in Relation to Sunspots*, 1923. C. Elton, "Periodical fluctuations in the number of animals," *British Journal of Experimental Biology*, vol. ii, No. 1, October 1924, Edinburgh University.

is in a position to gauge the universal field where these problems can alone be solved. Here we have been able to do no more than to show this universal field, emphasize its importance, and point out that only through the real co-operation of all sciences and of all nations can knowledge be born which will serve as a foundation for the building up of a world-embracing economy. What we most need is a form of organization, directed from the *universal* point of view, in the realms of education and research.

Chapter VIII

World Economy

THE term "World Economy" seems to have lost its meaning entirely, since all nations are doing their utmost to produce, as far as possible, everything within their own frontiers. The great agricultural states become industrialized, the great industrial states turn to agriculture. The polarities and distinctions which produce the degree of tension and balance on which all economic activity depends, seem to be disappearing, and a standstill in international economy would appear to be imminent.*

In spite of this, and although the international division of labour is at present retrogressive, it must be realized that this development is only a phase within a wider sphere of evolution. Not that it is suggested that the conditions preceding the present ones could return, but that the tendency to self-sufficiency of national units and isolation from international life is really only a phase of development. Supposing that all States had been successful in producing within their own frontiers everything made possible by climatic conditions; supposing that even the regulation of the climate itself had been achieved on a large scale, either by means of irrigation, reclamation, reforesting or by other perhaps still unknown measures; in the end the psychological national differences in character would infallibly lead to divergences in the working system and methods of production, which would again create those conditions of tension without which no interchange, and consequently no economic life, would ultimately be possible.

* Ferdinand Fried, *Das neue Weltbild*, especially chapters on "Reagrarisierung der Industrielaender," "Industrialisierung der Agrarstaaten," "Abkehr von der Monokultur," in which this process is described with references to the latest developments in the various countries. *Die Tat, unabhaengige Monatsschrift*, Jena, August 1934. Also *Wochenbericht des Institutes fuer Konjunkturforschung*, Berlin, February 2, 1934, *Der Welthandel.*

It is even probable that the differences which will then become apparent, will bring out the true characteristic distinctions between the nations much more clearly than the preceding period of specialization, because the period in which we are now living will have swept away all merely accidental differentiations. Therefore we must say that we are passing from a period of haphazard differentiation into one of fundamental distinctions, and that after the passing of this wave of transition—that is to say towards the end of this century—we shall experience a new development which will tend to bring the states, then highly independent as economic units, into a new earth-embracing relationship one to the other, in which each nation will participate in the full recognition of its national individuality.

But it could be of the greatest significance to anticipate this next phase in economic life even now, because it would enable us to face present development with a new strength.

It is, therefore, necessary to harmonize two aspects: an understanding of the special characteristics of each national economic unit, and an understanding of the specific relationships resulting from these characteristics, in view of the fact that these different national units must necessarily shape their economic life on an earth which belongs to them all.

First let us observe how far man has changed, or is planning to change, existing climatic conditions. More than 200 million acres (809,400 km.) are under irrigation.* In comparison with the size of the earth this is very little. But if we study a comprehensive description, such as E. H. Carrier gives us in his work entitled *The Thirsty Earth*,† we receive the impression, that much irrigation work was completed in old historic times, so that the possibility of the extension of irrigation on a large scale certainly exists. Districts which in the distant past

* B. C. in *Nature*, July 1933, referring to Orson W. Israelsen. Book on irrigation.

† E. H. Carrier, *The Thirsty Earth*, A study in irrigation. Christophers, London, 1928.

had been made fertile by this means have been allowed to lie waste in succeeding cultural epochs, and it becomes man's task to renew the work of his ancestors. Syria, Egypt, Babylon, Iraq, Turkestan, and China can look back on great achievements in this direction, and so can the modern western world. We could not in our time, richer though we be in technical resources, go to much greater lengths of achievement.* We see, in practice, great irrigation schemes materializing in Egypt. The Egyptian Ministry of Public Works is at present engaged on a comprehensive plan for water regulation and irrigation in Egypt, which contemplates the construction of numerous buildings and irrigation works in the course of the next twenty years. The major part of these works will be concentrated in the provinces of Scharkie and Garbie. The Egyptian Ministry of Finance is at present also engaged upon the preparation of a ten-year construction plan.†

The Aswan dam will pile up the water of the Nile for 230 miles above Aswan to Wadi Halfa on the Sudanese border. Stored behind this new dam will be 1,320 billion gallons of water. Here is a comparative table showing measures taken formerly to regulate the Nile:

Aswan dam	590	miles	above	Cairo	1902
Esna Barrage	490	,,	,,	,,	1909
Nag Hamdi	367	,,	,,	,,	1930
Assuit	250	,,	,,	,,	1902
Delta	15	,,	below	,,	1890
Zifta	17	,,	,,	,,	1903

In the Nile delta, extensive works have also been carried out to remove the salt from the soil and to make it fertile. Other great schemes of a similar nature are operating, such as in the Zuider Zee,‡ in Greece near Salonica (600 square miles), and in Italy, where by his grand scheme of cultivating the Pontine Marshes,

* See Index Volume of the transactions of the first World Power Conference, London, 1924, under "Irrigation," where all countries are separately enumerated.

† *Deutsche Bergwerkszeitung*, July 2, 1934.

‡ *Engineering News*. Record of December 1, 1932, gives a description.

Mussolini has drained considerable stretches of land by means of building canals. Further there is the irrigation scheme in connection with the waters of the Rio Grande and of the Colorado River, and other such works are being carried out in Mexico. All this may serve as proof that new land is continually being drained, or irrigated, or wrested from the sea. The conceptions formed by Paul Hirth* have made it possible to separate the humid and arid zones of the earth more exactly from a cartographic viewpoint. Heiderich-Sieger gives a map of the future irrigation of the earth on the basis of Hirth's conceptions.† This map shows that if man should really carry this out and irrigate all those parts of the earth which have a rain factor‡ below 40, the whole climate of the earth would be changed.

How far man is able to master the climate is a question which has been repeatedly discussed.§ It is impossible to theorize further on this question as new discoveries in this realm are always being made and each day may bring undreamed of possibilities. The numerous voices to the contrary, therefore, have no absolute or final value. There is no doubt that some day, not only by means of irrigation and afforestation but by controlling the distribution of warmth over the earth, man will have to assume full responsibility for the whole planet. When the technical possibility becomes reality, we must be morally prepared for it, because on the dis-

* Paul Hirth, *Grundzuege einer Geographie der Kuenstlichen Bewaesserung Dissertation Halle*, 1921, and *Beiheft zum Tropenpflanzer*, 1928. Paul Hirth, "Isonotiden und deren Erdkarte" (Isonotides are lines of equal rain factors), *Petermanns Mitteilungen*, Table 9 and pp. 145–9, 1926.

† Andree-Heiderich-Sieger, *Geographie des Welthandels*, vol. iii, p. 15, 1930.

‡ The rain factor is the quotient of the quantity of rain given in mm. and of the temperature given in degrees of Celsius. Hirth pointed out, that this bringing into relation of rainfall and temperature is necessary, because with increased evaporation, due to higher temperature, there is an increased absorption of rainfall. It is consequently this quotient which interests the farmer. The growth of corn demands irrigation wherever the rain factor falls below 40.

§ A. Wendler, "Problem der technischen Wetterbeeinflussung" in *Probleme der kosmischen Physik*, Ch. Jensen and A. Wassmann, Hamburg, 1927.

tribution of warmth and humidity depends the whole plant world.*

We must realize, then, that a study of the laws of distribution on the surface of the earth is not merely a hobby, but a science which will, sooner or later, have to be taken seriously and brought to a practical issue. This cannot be done, however, merely from a one-sided national point of view, in spite of the fact that national development is of great value and of very special importance for the welfare of the psychological realm in economic life to which all questions connected with labour belong. The number of working hours, the standard of living; these are some of the psychological national questions relating to economic life. The administration and ordering of the planet is a matter which concerns mankind, and the question of the distribution and use of raw materials is one of these matters.

In this field arises the task of taking a true world inventory with absolute impartiality, in order that on the basis of actual facts, reasonable negotiations between the economic units on matters of raw materials may gradually become possible. The more removed these are from politics and the more they are guided by the pure necessities of economic life, the greater will be the chance of success.

That present economic life really contains world problems which could be tackled, is explained among other things in a very interesting article by Oscar Oliven, entitled "Europa's Grosskraftlinien," which was presented to the Second World Power Conference in Berlin.† The importance of these reflections is shown in the fact that the solution of a technical problem lies in bringing it into harmony with the cosmic rhythm—that is with the rhythm of the earth. The author shows the economic advantages which would be derived from the installation of a European net of electric power stations ranged in such a way (north-south) that in

* F. Enquist, *Geol. Foeren. Foerh.*, 1924, shows the boundaries of the plants according to warm and cold zones.

† *Gesamtbericht der "Weltkraftkonferenz,"* Berlin, vol. xix, 1930.

taking advantage of all the water and coal resources, one would be able to regard the differences, produced by summer and winter conditions in the various parts of the earth as well as the west-east differences in daylight. The following suggestions, which are worked out in full and concrete detail, could well be carried out: "An electric connection between the waterpower in the Higher Alps, which on account of the melting of the snow reach their maximum in the summer; the as yet uncompleted hydraulic works of the Danube at the Iron Gate; and, lastly, similar uncompleted hydraulic works on the Adriatic Coast, where atmospheric depressions in winter cause extensive rainfall. Such a connection will produce a balance of power, which will make it possible to avoid the building of great dams, or at any rate to leave them to a far distant future. . . ."

Nature provides a constant storage of water by means of the uneven climatic and atmospheric conditions of that whole section of the earth, and if this natural supply of water is utilized at the right time and in the right places and it can be made available at given points through high-tension electric grids, we shall benefit considerably by getting better results at lower costs. Furthermore, it will be possible to incorporate the existing thermo-stations into this system. The author also draws our attention to the water powers of the Scandinavian peninsula, unused up till now, as well as to the Galician and Roumanian oil fields and the South Russian and English coal fields, all of which would be within this European net.

Those who wish to familiarize themselves with all the details of the project, must study Oliven's work. Our own present task is merely to show how a world economy opens purely economic problems which differ entirely from those which are bound up in the aspect of "national economy."

The objection which might be raised against these ideas, namely, that they could never be realized because present psychology presents an unsurmountable obstacle, does not nevertheless hold good. It must be admitted

that not even districts within the same State like to be dependent on one another in the production and supply of power; but if only men could be persuaded to tackle these problems in a truly broad-minded way, "psychology" would follow soon enough, because that which is right and reasonable triumphs in the end, however great the obstacles may be. Should we not believe that a cosmopolitan way of thinking can only strengthen our feelings for our country as a well-ordered member of a well-ordered harmonious whole, and that measures could be taken to ensure both love for the whole AND love for one's own country?

When we look at the present world situation we cannot help wondering whether the economic problems are not, after all, pedagogic problems! How can we train ourselves to think economically? That is the question, and not, how can we bring absolute nonsense and complete chaos into a scientific system of economic laws?

Let us, both as single nations and as humanity in general, turn back to the point where we began, to the soil, to the earth!

When the earth is regarded once more as something holy, when the earth will once more have a voice in the solutions of the great world problem, only then will a dawn of true prosperity and health rise upon humanity.

But the earth is silent. She is the mute *Ase* of which the story of the twilight of the gods speaks in the Nordic legend; the *Ase*, the god who outlasts the war of all against all, and, after the great chaos, orders everything anew.

The chaos is here. The *Ase* outlasts it. The earth remains true to us.

Could we not find men to loosen the tongue of the silent god—men ready to live and work together to the end that well-being, peace and harmony may arise out of an honest striving for the highest good?

[The following article is an attempt to describe in general terms the necessary initial steps for the rational organization of world economy. It is based on studies that have appeared in previous issues of THE PRESENT AGE. Stress is laid on the crucial problem of world economy at the present time, viz. the price of gold.—EDITOR.]

The Organization of World Economy

STEPS TOWARDS ITS ATTAINMENT

by

D. FERGUSON, M.A.

IN the nineteenth century, for the first time in history, mankind discovered methods of matter transformation adequate to secure control of economic resources. The twentieth century witnessed the application of these methods, but although it is generally admitted that the means are even now in existence whereby extreme want in any part of the world could be almost immediately relieved, the organization of world economy or the co-ordination of scientific discovery with material resources on an international scale has so far not been attempted.

One of the reasons for this lack of initiative has been the necessarily analytical psychology of the scientists of the world. Each specialist has tended to regard his own little sphere of interest and his own theories and discoveries in that sphere as being of fundamental importance to the welfare of the universe—and this egotistical attitude is entirely pardonable; it is indeed essential to the idea of progress, for scientists, like prophets, cannot live without faith—faith in their subject.

The consequence of this scientific individualism has

been a totally uneven advance of knowledge in all its various branches. Physical and material sciences with their so-called "definite" bases have far outstripped the social sciences with their relatively small possibilities of the application of measurement. Consequently, the hiatus between scientific discovery and its sociological applications has tended to increase. There has been a complete lack of co-ordination of theory and discovery with its practical utilization, and there is strong evidence to suggest that this hiatus cannot be eliminated by scientific workers on the one hand or by statesmen on the other. The necessity for the collaboration of the two is becoming more and more apparent.

As regards the scientists, a prime necessity would appear to be the adoption of a more synthetic approach even in purely scientific problems. With the vast volume of individual discoveries available in every subject, it would seem that the greatest possibility of rapid advance is offered by a more complete scientific synthesis than has ever yet been attempted. As regards the statesmen, it is apparent that their lack of knowledge of the sociological consequences of discovery and of the possibilities of the reorganization of world economy offered by science may lead to tragic results in the near future.

All the evidence of science and sociology suggests therefore that the nature of the problems facing the next World Economic Conference will be mainly synthetic, and less analytical than is generally imagined. In other words, its task, gigantic and grandiloquent though it may sound, is nothing less than an international synthesis of knowledge, and the organization of the initiative in the application of this synthesis to world economy. This is the fundamental task and mission of the twentieth century.

At the risk of appearing presumptuous, the writer suggests a programme of fundamental scientific research which will require to be undertaken for the elucidation of the many political problems of the present time and probably of the near future. In May 1937 THE PRESENT AGE published an outline of the more financial and fiscal

aspects of the problems of world economy, and although the writer believes that these aspects are fundamental—possibly because he has devoted most of his attention to them—the necessity for a very wide outlook in the approach to those problems, wider indeed than that comprised in purely monetary and financial studies, must be admitted.

The investigation of the possibilities of co-ordination of scientific knowledge, economic research and its sociological applications obviously necessitates the establishment of an authoritative and permanent Institute of World Research. As the greatest immediate need is for world *economic* research, capable investigators in pure and applied sciences should be invited to state their views or undertake inquiries on the relation of their individual subject and its effect on the following problems.

1. World Population Movements.
2. Food and Raw Material Resources and their Exploitation.
3. World Labour Supplies including Machinery Production and Utilization of Labour-Saving Devices.
4. Transport and Communications and their Economic Influence.
5. International Distribution of Commodities.
6. World Consumption and its Fluctuations.
7. World Price Formation and its Processes.
8. National and International Monetary Organization.
9. National and International Banking Organization.
10. International Trade.

It is the writer's belief that if the scientists of the world could be prevailed upon to contribute the results of their investigations in relation to the above subjects in such a form that a synthesis could be obtained of the dominating forces influencing world economic rhythm, if further definite statistical relationships of their economic influence could be established between the above ten groups

on a world basis so that a concrete and definite system could be constructed and formulated in an unchallengeable economic theory, the initial stages in the conscious organization of world economy would thereby be attained.

The objection may be made that the probabilities of a practicable theory emerging may be very small. It should, however, be stated that judging from preliminary investigations which have appeared in THE PRESENT AGE it is highly probable that such a theory could be established and formulated, but the scientific labour required for its complete confirmation is such that it does not seem possible that any individual investigator could carry out the research essential for this purpose.

Nevertheless, whether this purely personal opinion be true or otherwise, it is plain that unless the vast problems of "the impact of science on society," as Sir Josiah Stamp terms it, are attacked and studied in a concrete fashion based on the fundamental element of statistical magnitudes and organized on a totalitarian international scale—this is the task of the next Economic Conference —the outlook for the future of the world is very black indeed.

* * *

The general problems of world economy are outlined above. A more immediate and topical problem of great importance, affecting the whole future of world economy, has arisen in the last few weeks, the problem of the price of gold. South Africa is naturally eager that the price of gold be maintained. The United States faced with an influx of yellow metal which may upset the whole national economy, is trying to ward it off by "sterilization" measures. Rumours of a reduction in the price of gold have upset the stock exchanges of the world. And although the foreign exchange rates of most countries are not tied to gold at any fixed level, the volume of deposits and of currency in circulation, is still, despite the suspension of the Gold Standard, dependent on gold holdings. Moreover, central banks cannot buy gold except by

increasing deposits with a consequent inflatiency effect at a dangerous juncture in world trade, or by issuing Treasury Bills in exchange and increasing government. This latter process is taking place both in the United Kingdom and the United States.

There is obviously a limit to this process of subsidization of gold production. But if the Bank of England and the Federal Reserve Bank ceased to purchase gold at increasingly high prices in the near future, a trade depression would be initiated compared with which the cost of the gold subsidy would be negligible. Conversely, a rise in the price of gold would have an inflationist influence which, in the long run, could only lead to world-wide economic catastrophe.

The great need therefore is the stabilization of the price of gold. But how is this stabilization to be effected? No one seems to know. It has been suggested that a redistribution of gold might be effected by an increase of foreign lending and a revival of foreign trade.

These, however, are merely temporary palliatives. They do not provide a definite precise mathematical answer or mechanism as to what is to be done about the price of gold and how that price is to be regulated.

Vague suggestion has been followed by fantastic rumour. The United States was going to reduce the price of gold, or place a tariff on gold imports or fix an import quota or cease buying gold. The United Kingdom would reduce the sterling price of gold to maintain parity with the dollar. It was going to reduce the sterling price of gold only in part. Finally, it was going to adopt a policy of masterly inactivity and do nothing.

It is not the purpose of this article to describe the economic consequences of any hypothetical action by the monetary and financial authorities of individual nations, and the above examples of rumour and suggestion are cited merely to demonstrate how chaotic the condition of the international monetary mechanism has become. In all the conflict of theory and opinion, it has not been possible to discover any solution based on the facts of a

comprehensive world economy and capable of immediate application in every country.

The reasons for the confusion are fairly obvious. The suspension of the Gold Standard in its more or less pristine purity placed the command of the world's capital and money markets in the hands of Governments because they can now directly or indirectly determine the price of gold. "The Government is to-day one of the biggest borrowers and lenders in the market. Equally it is in a position to determine how much gold shall lie behind our credit base, for it is free to switch our total supplies of gold about between the Bank of England and the Exchange Equalization Account. It imposes an unofficial but very real control over all foreign long-term borrowing and certain kinds of home borrowing. It has relieved the Bank from any drain upon its gold reserves, unless the Government itself decides to initiate such a drain not abroad, but into the Exchange Equalization Account. The practical import of these changes is threefold. First we have a much more delicate and elastic monetary machine, and it is not certain that the authorities have entirely learned how to use it." *Economist*, May 8, 1937.

It is to be feared therefore that each Government will base its monetary policy purely on considerations of self-interest. Until, therefore, the Gold Standard has been restored in such a form that will not inflict the grievous harm to world economy which compelled the nations to discard it as the regulator of international exchange, it is futile to expect economic peace. And economic war is the essential element of real war.

The new Gold Standard should utilize gold stocks as a medium of monetary control, itself controlled by the fluctuations of world agricultural production. No apology is offered for repeating part of the argument in the article, in the May issue of THE PRESENT AGE: "International Economics and World Economy." The problem then did not appear likely to become acute for some time. But now it is apparent that we are at a critical juncture in the world's history. Mankind has never yet mastered the

proper use of gold. Is it to grope through another thousand years of monetary upheaval and perish because of inability to adapt itself?

We repeat, therefore, that if the gold cover of the note issues of all the central banks of the world were comprised in an international monetary mechanism whereby they moved or were forced or allowed to move in conjunction with the long-term fluctuations of world production and stocks of foodstuffs, international price stabilization would be a comparatively simple matter, and the first fundamental problem of world economy would be solved.

World monetary standards would be regulated by the rhythm of world production, and an automatic mechanism of an elastic but nevertheless definite nature would eliminate national politics from international economics.

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