CONDITIONS NECESSARY FOR THE PROTECTION OF THE WORLD CLIMATE AS SEEN BY A SEAMAN AND LAWYER

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A. Introduction

For the last 150 years, two areas of modern science have been concerned with the climate: meteorology and the scientists who have studied questions of geophysics in its widest sense. These include among their number the physicist Svante Arrhenius, who was awarded the Nobel Prize for Chemistry in 1903.

I. Climate as an Offshoot of Meteorology

In briefly summarizing the contributions of meteorology, a notable starting point is the first article in the *Meteorologische Zeitschrift*, which has been appearing since January 1884. It was a report of the volcanic eruptions of the year 1883, particularly that of Krakatoa in the Sunda Strait, Indonesia. The first sentence in this venerable journal was written by Director Neumayer of the German Sea Observatory and reads: "The year 1883 will take a remarkable place in the history of earth with respect to the effects of the earth's interior on the crust and everything found upon it." He meant that the effects of volcanic activity on the atmosphere surrounding the earth would be of particular interest.[1] Although the eruption of Krakatoa caused a notable reduction in the amount of solar radiation reaching the earth's surface for a number of years, meteorological interest soon dwindled away. The weather continued just as it had before. Since the concept of climate was defined at that time, just as today, as the average weather over a long period of time and the Krakatoa eruption did not cause a major disruption in the statistics, the flurry of scientific advance which Neumayer expected failed to occur. Meteorology did not recognize important relationships between the events.[2]

II. Research into Greenhouse Gases as an Abstract Discipline

But the atmosphere is not the domain of meteorologists alone. Since the beginning of the last century, a number of natural scientists in other fields have been studying the effects of carbon dioxide on the warming of the earth's atmosphere; as early as 1827, the effects of gases in the atmosphere were compared with shielding by glass.[3] In 1956, Plass stated that a century of scientific work had been necessary to calculate with any

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[1]Neumayer, Report on the Volcanic Eruptions of the Year 1883, Describing Their Effects on the Atmosphere, *Meteorologische Zeitschrift*, January 1884, P. 1

[z]Cf. Wexler, H., On the Effect of Volcanic Dust on Insolation and Weather, Bulletin American Meteorological Society, Vol. 32, Jan. 1951, Pp. 10-15 and Pp. A8-51, containing further references; Wagner, Artur, Climatic Changes and Climatic Fluctuations, Brunswich 1940, P. 42.

[3]For details, cf. Plass, Gilbert N., The Carbon Dioxide Theory of Climate Change, Tellus, Vol. 8, 1956, Pp. 140-154 (140).

accuracy the amount and effect of CO_2.- He expressed the opinion that a doubling of the CO_2 concentration in the atmosphere would raise the temperature of the air by 3.6° C. and that the evidence currently available indicated that the concentration of CO_2 was a significant factor for climatic changes.[3]

Nonetheless, the theory did not begin to find general recognition[6] until it was seen that a cold period which had begun in 1940 came to an end in the middle of the 1960s and that the warmest summers of this century was recorded since 1980, that the Sahara began to expand, that the El Nino did not maintain its seven-year rhythm, and that beginning in 1985 North America had to suffer through drought periods. More and more scientists saw a relationship between CO_2 emissions and the warming of the atmosphere. But it was not until the Chief Climatologist of the NASA, James Hansen, stated on June 23, 1988, before a US Senate Committee that a greenhouse effect was beginning to develop and that he was 99% certain of this[7], that the greenhouse theoreticians won general recognition.

III. United for Rio

To the great joy of environmentalists and, for a while, to the annoyance of many meteorologists[8], the greenhouse effect became an omnipresent topic for the press, a worried public, and frightened politicians. Never before had a scientific problem risen to such dominance in the political arena, it was said[5] and no one wanted to be left out in the cold. Science was united. The forum was the "Intergovernmental Panel on Climate Change" (IPCC)[10] organized by the United Nations. In little more than a year, a

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[4] Ibid, P. 140. F. Möller was critical of this viewpoint ven then: cf. On the Influence of Changes in the CO_2 Concentration in Air on the Radiation
Balance of the Earth's Surface and on the Climate, Journal of Geophysical Research, Vol. 68, 1963, Pp. 3877-3886.

[5] Plass, op. cit., P. 154. Today, the amount of literature on the CO_2 effect
is overwhelming. Cf. for example Crutzen, Paul J., in: Crutzen/Muller, The End of the Blue Planet?, Munich 1989, Pp. 25-43; Investigative Committee of the llth German Parliament, Protection of the Earth, Bonn, 1990, Pp.139-240; Kondragyeo, K. YA., New Assessments of Global Climate Change, Atmosfera, 1991, Pp. 177-188; Elsom, Derek M., Atmospheric Pollution, Oxford 1992, Pp. 132-165.

[6] S. H. Schneider, for example, twenty years ago denied any elevance of CO_2 for the warming effect, declaring that it was "highly unlikely for the next thousand years", cf. Rasool, S.I., & Schneider, S.H., Atmospheric Carbon and Aerosols, Science Vol 173, 1971, P. 138. Cf. also the (hidden) reference in his book: Global Warming, San Francisco 1989, Footnote 17 in Chapter 4, where he backed down from his statement.

[7] Cf. Schneider, S.H., Global Warming, San Francisco 1989, Pp. 194-195.

[s] lbid; cf. also Henderson-Sellers, A. Greenhouse Guessing: When Should Scientists Speak Out, Climate Change, Vol 16, 1990, Pp. 5-8 (8): "Many of my colleagues in the meteorological community argue that no statements should be made until we are absolutely certain!"

[9] Houghton, John, World Climate Needs Concerted Action, in Financial Times, 11 November, 1990. Houghton was the Chairperson of the Scientific Committe on Climatic Change of the IPCC.

[10] The Panel was established by the UN Environment Programme (UNEP) and the World Meteorology Organisation (WMO) at the end of 1988.

report was prepared through the co-operation of virtually all researchers who had made important contributions to the study of climatic changes[11] and presented to international politics at the Second World Climate Conference in Geneva in November 1990.[12] In January 1992, the IPCC confirmed these results.[13] Even the IPCC report of 1990 left little room for scientific doubt with respect to the relevance of CO_2 for the climate[1"] and declared that it was no longer a question of if, but at the most of how fast the climatic changes would occur. The conclusion of a climate convention with the primary goal of permanently reducing the greenhouse gas emissions was urgently required.[1']

At the Environmental Summit in Rio de Janeiro from *3* to 14 June, 1992,[ls] this demand was made the centerpiece of international politics. During the Summit itself, 154 states signed the "United Nations Framework Agreement on Climatic Change." Nevertheless, the criticism of the agreement could not be overlooked. But this criticism was not aimed at the "whether" or "how", but at the fact that politicians were unable to agree on more decisive measures to reduce greenhouse gases.[17] The extreme stumbling blocks in the negotiations were basically a result of the unwillingness of the USA to agree to a binding determination of CO_2 quotas. The General Secretary of the Conference, Maurice Strong, remarked: "The weight of evidence is that the climate is in danger, but the Convention is not enough . . . The real test is, will it soon lead to reductions in the polluting gases that threaten the atmosphere."[18] German Environmental Minister Klaus Töpfer intends to

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"Houghton, op. cit. (Footnote 9); Cf. Andresen, Steinar, The Climate Negotiations: Lessons and Learning, International Challenges, Vol. 12, No. *2*, 1992, Pp. 34-43 (40)

[1=]Jager, J., & Ferguson, H. L. (ed), Climate Change: Science, Impacts and Policy. Proceedings of the Second World Climate Conference, Cambridge 1991; this is a summary of the various work groups of the IPCC.

"Financial Times, 28 May, 1992, with reference to: IPCC: Climate Change, Cambridge 1992

[l]*In summarizing the results of the IPCC, Bert Bolin wrote in: Jager/Ferguson (ed), op. cit. (Footnote 12), P. 19: "There is a greenhouse effect, that is at present being enhanced by man due to emissions of a number of the so-called greenhouse gases" and "we can tell with confidence that (climate change) is going to be significant if present increse of the emissions continue without constraints." One of the few critical voices was, for example: Thomas, David, The Cracks in the Greenhouse Theory, Financial Times (Weekend FT) 3/4 November, 1990; furthermore, Lunde, Leiv, Science and Politics in the Greenhouse. How Robust is the IPCC Consensus? in: International Challenge, Vol. 11, 1991, Pp. 48-57, with additional references.

[15]Jager, J., & Ferguson, H. L. op. cit. (Footnote 12), P. 498.

[ls]United Nations Conference on Environment and Development (UNCED); the preparatory conference was called on the basis of a decision by the UN General Assembly on 22 December, 1989; cf. Environmental Policy and Law, Vol. 20, 1990, Pp. 72-73 and Pp. 96-97.

[17]The negotiations for the Climate Convention were concluded after almost 18 months of work on 9 May, 1992 (The Int. Herald Tribune, 11 May, 1992, Global-Warming Pact Without Targets Gets U.S. Approval).

[18]The Guardian, 15 June, 1992 (Brown/Rocha, World Leaders Put on Probation by Rio Organiser)

act to ensure that the climate convention serves a purpose. "Our first goal is a follow-up conference to the Climate Convention where we can get down to serious business," he declared at the end of the Earth Summit in Rio.[19]

As other voices have also commented that while the results were not optimal, at least they were a beginning[20] and it was now only necessary to continue steadfastly along the road chosen, it appears as if climate history has already been written and only a determination of the amount of the quotas for the reduction of greenhouse gases, binding on all, is lacking for the protection of the climate. But this could prove to be a dramatic mistake.

IV. Defining the Problem

1. The Second Step - Writing the Laws

When a problem has been recognized, the desire for a solution begins to grow. A plan must be made. The plan must be feasible. The legislature,
1.e., the jurist, must step into action. Plans for the protection of the climate can be made only if the situation is described precisely and the goals and the extent of rights and obligations are set. This is done by means of applicable and enforceable laws and rules. Laws and international agreements are therefore the *ultima ratio* for overcoming conflicts and problems. It was therefore only natural that scientists at the Second World Climate Conference in Geneva in November 1990 should demand that the nations begin immediately with negotiations on a climate convention so that such a document could be signed in 1992. Legislative action is therefore a substantial element of working out problems, and there is no need to explain why an evaluation from the viewpoint of a lawyer is offered here.

2. The First Step - The Facts to be Considered

Just as an attorney cannot properly represent his client unless he has been given detailed - and accurate - information about the situation, the quality of laws is as a general rule dependent to a considerable extent on how well, how precisely, and how extensively the legislature has been informed of the situation being regulated. To the extent that scientific opinion represented in the Intergovernmental Panel on Climate Change (IPCC) was able to show that greenhouse gases, global warming, and climatic change are joined to one another in a causal relationship, the Climate Convention of Rio could serve as the foundation of a suitable instrument.

This presumes, however, that the description of the situation was an

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[19]ln: *Frankfurter Rundschau,* 16 June, 1992 (Wille, J.: "At the Beginning of a Necessary, Dramatic Process"); cf. also Brown, Paul, who wrote in the Guardian (15 June, 1992): "But Europe and Japan regard the convention as weak, ducking specific promises on carbon dioxide reductions to accommodate the United States. Politicians have repeated many times in the main conference, however, their hopes that this is only the beginning of the process."

[20]Cf. for example Int. Herald Tribune (The New York Times), 16 June, 1992: "But now, after the Earth Summit, there is a road"; Nature, "Two successful weeks at Rio", Vol. 357, 18 June, 1992, P. 523.

adequate representation of the problem. Yet there are considerable reservations about precisely this point. After acid rain and the ozone hole were recognized some years ago as serious environmental problems, now the weather is supposedly in danger. As everyone has always been intensely concerned with the weather, the general public was seriously frightened and politicians came under heavy pressure. Within a year after James Hansen's famous appearance before the US Congressional Committee, the government leaders of the seven industrialized states formulated the following in Paris in 1989: "The increasing complexity of the issues related to the protection of the atmosphere calls for innovative solutions."[21]

So even top levels of politics were quickly convinced that the climate was an atmospheric phenomenon. But this description of the situation is too vague to allow for effective climate protection. From the "point of view of a seaman" - sailors are known to be more concerned with the ocean than with the atmosphere over the seas - there should first be a discussion as to whether the situational conditions described at the Rio Conference were concrete enough to allow a long-term resolution of the climate problem. Although it has been more than twenty years since this writer sailed the seas as a captain, it is perhaps still correct to apply the following remarks of Neumayer from the year 1884 to him: "These notes should be valued all the more highly as they come from seamen whose years of observations at sea have accustomed them to recording and describing by simple means natural phenomena, while, being temporarily isolated as they are, cannot be influenced in their observations and descriptions."[22]

This is perhaps applicable, as the basis for his understanding of the climate from the "viewpoint of a seaman" had already been established more than thirty years ago, when he was a young deck officer. Even though he was no more able than others to avoid the euphoria of the opening of the age of space exploration, he regarded the harnessing of technical advance for research into the oceans as the greater necessity. For long-term and reliable weather forecasts can only be achieved on the basis of thorough knowledge of the seas. As this is still lacking, it was possible for the London "Times" only a few months ago to remark sarcastically in an editorial: "Absolute unpredictability is weather's defining virtue. Perhaps that is what our unintelligible forecasters are trying to say."[23]

The first part of the following discussion will be concerned with determining the factors which appear necessary for climate protection, and then there will be a probing of the legal components.

V. Note

To begin with, a basic assumption must be stated to avoid possible misunderstandings. The damage to the environment caused by gas emissions into the atmosphere is not being questioned. Efforts to conserve energy by reducing CO_2 are also not

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[21]Minutes (No. 45, 1st sentence) of the Summit of the Arch, 16 July, 1989, printed in: The New York Times, 17 July, 1989, P. A7; US State Bulletin, September 1989.
[22]op. cit. (Footnote 1) Pp. 3/4.
"The Times, 29 February, 1992, (Questioning weather).

protection of the climate are adequate as a basis tor convincing pians or whether further steps are required.

B. Conditions for Planning - The Situation

I. Statistics on Rising Temperatures

There are lies, damned lies, and then there are statistics, complained a statesman and author.[2,1] But they are unavoidable,[23] and when one looks at the history of the greenhouse discussion, there are so many statistics involved, not to mention computers and simulations, that a short recital of statistical basic values should not be lacking here.

If the sun were "turned off," the temperature of the atmosphere would be only 28" C. above absolute zero, i.e., at -245° C. With the sun, but without water, the average temperature on earth would be -11" C., resulting from a daytime temperature of approximately +135° C. and a nighttime temperature of approximately -155° C.[26]

If we continue to work with average figures, we could get the impression that even including the global water masses would not change much. The oceans have an average temperature of +5° C. and the atmosphere registers -17° C. If you take the average of these, then you have -6° C., a value which is not very far removed from the -11" C. of a waterless planet. If we wanted to draw conclusions from this situation, it would appear logical to argue that water has little to do with the warmth of the earth. But in doing so, we would have allowed ourselves to be "drawn in" by statistics. Taking another standpoint, the world looks completely different.

The starting point is that the oceans are huge and deep. If all of the continents were leveled off to *a* depth of 3000 meters and the excess dumped into the deep seas so that the land surface all over the globe were equidistant from the center of the earth, the globe would then be covered by an ocean with a depth of almost 3000 meters. The ocean is a factor which cannot be ignored, even if it has withdrawn from 1/3 of the earth's surface, exposing land.

For one of the principal elements in climatic activity is the capacity of water to store heat. Whereas the seaman hardly notices any difference between daytime and nighttime temperatures, the Bedouin in the desert regularly has to contend with a drop in temperature of 20° C. and more

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[2]"Disraeli, S. (1804-1881), Engl. Prime Minister, noted by A. Henderson-Sellers, op. cit. (Footnote 8), P. 6.

[25]Monin, A. S., writes in An Introduction to the Theory of Climate, Dordrecht 1986, P. 6: "We don't have to know the individual chronological sequence of states of the atmosphere-ocean-land system. Rather we must have statistics of the states, that is their limits of variation and their frequence of occurrence over a long time interval." Cf. the discussion of the nature of the climate in this paper.

[26]For the temperature effect of water, cf. Gross, M. Grant, Oceanography, 5th Edition, Englewood Cliffs, 1990, P. 87; Monin, A. S. op. cit., Pp. 114-120.

every night. Neither land nor dry air are capable of maintaining a constant temperature even for a short periods of time without replenishment of energy by the sun. The best-known phenomenon which demonstrates this is the land wind which begins only a few hours after sunset.[27] The day-to-day experience is only one of a change back and forth, because as soon as the sun has been above the horizon for only a couple of hours, the sea wind begins, i.e., the cooler air above the ocean is pulled in over the land masses. But in explaining the functions of the natural systems, the examples are helpful starting points to aid understanding. For we can come to the conclusion that, from a climatic point of view, the oceans dominate the land masses, here over a very short period of time.

If the atmosphere is divided into its two warmth or energy bearers, water and greenhouse gases (CO_2, methane, etc.), then the atmospheric humidity has as much warmth capacity as a two-meter layer of ocean water, the greenhouse gases as much as a one-meter layer. In practice, this means that that a rise in the temperature of the atmosphere of 1° C. must cause a drop of the same amount in the upper three meters of the ocean.[28]

The elementary dimensional relationships of the upper 240 meters of the oceans, the atmosphere, and the land have been worked out in impressive fashion by A. S. Monin. After determining the mass relations of 16.4 to 1 to 0.45, he defines the warmth capacity ratio for the oceans as 68.5, for the atmosphere as 1, and for the land as 0.45.[29] As *2/3* of the warmth capacity of the atmosphere is accounted for by humidity, there is a ratio between CO_2, methane, etc., and the upper 240 meters of water of 1:215. Based on an average ocean depth of over 3600 meters, the ratio is no doubt far above 1:2000.[30]

The current discussion does not involve the general warmth capacity of the atmosphere, but has to do with the importance of the increase in greenhouse gas values. In 1990, the concentration of CO_2 was about 25% higher than around 200 years ago (increase from 280 ppmv to 353 ppmv).[31] If it is a question of a statistical valuation of the warmth potential, we could think about taking the effect of a layer of sea water of just 0.25 meter depth for comparison. But this would be an undervaluation of even this thin layer. After all, the sun is involved in the process every day, and "approximately 80% of the solar energy intercepted by our planet enters the atmosphere over the oceans." [32]

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[27]Weischet, W.: *Einfuhrung in die Allgemeine Klimatologie,* Stuttgart 1988, P. 121, explains this as follows: "This is due to the fact that the nightly cooling affects a layer of only 300 to 500 meters, whereas the warming effecting during the day affects 1000 to 1500 meters."

[28]Stanton, B. R., Ocean Circulation and Ocean-Atmosphere Exchanges, Climate Change, Vol, 18, 1991, Pp. 175-194 (176).

[29]Monin, A. S., op. cit. (Footnote 25), P. 2.

[30]According to W. Weischet, op. cit. (Footnote 27), Pp. 73-74, the ratio of the specific warmth for (still) water and air is 1:0.24, and one cm^3 of water requires 10,000 times as many calories for warming as the air near the earth.

[31]Cf. Siegenthaler, U. & Sanhueza, E., Greenhouse Gases and Other Climate Forcing, in: Jager/Ferguson (ed), op. cit. (Footnote 12), Pp. 47-58.

[3i!]Woods, J. D. quoted in: Houghton, John T. (Ed), The Global Climate,

As a considerable amount of the heat energy absorbed by the oceans is released immediately, only a few centimeters of the ocean's upper layer can have a more long-lasting effect on the average air temperature than other factors. But the world of statistics will hardly be able to provide an answer as to whether this is really the case, no matter how many comparisons we make. Nevertheless, such comparisons indicate that the rise in temperature known as "global warming" is not necessarily in essence an atmospheric event.

II. The Distant Ocean

1. Facts or Feeling

When in "The Encyclopedia of Climatology" we read the sentence: "The ocean is closer to *a* state of dynamic equilibrium than the atmosphere,"[33] or when GraBl/Klingholz state that the oceans are very, very slow to react,[3]" the question arises as to what led to these determinations. Are they based on "feeling" or on logical conclusions based on observed conditions? The physical dimensions of events in nature show a different face in any case. For if a cubic meter of water contains more energy than an air column several kilometers high, than even a hurricane with winds of 100 km/h is not much more dynamic than an ocean current traveling only a few km/h. If the oceans did not contribute their part to heat stability of the atmosphere second for second, hour for hour (land wind), etc., the world would look much different. The quoted statements are relative and indicate that the oceans have not been really taken into account in science's observations. The conceptual world so strongly formed by daily experience of atmospheric activities appears to hinder "dimensionally correct" comparisons with the oceans.[33] Even the director of the German Sea Observatory quoted above, Neumayer, spoke only of interest in the effects of the volcanic eruptions in 1883 on the layers of air surrounding the earth.[36] At that time and until the recent past, the oceans were hardly taken into account in the effort to understand atmospheric phenomena. Even in 988, James Hansen (see above) and the representatives of the greenhouse theory relied on the analysis of statistics to support their theses. Statistics aided by computer simulations. celebrated hitherto unknown triumphs.

Cambridge, 1984, P. 142.

[33]Kraus, Eric B., in: Fairbridge, Rhodes W. (ed), The Encyclopeida of Climatology, New York 1987, P. 639.

[34]Gra61, Hartmut, & Klingholz, Reiner, *Wir Klimamacher*, Frankfurt 1990, P. 123.

[3s]Regarding this point, Keith Clayton, Scaling Environmental Problems, Geography 1991, Pp. 2-15 (5) notes sarcastically: "We are remarkably land-centred. Even Ron Johnston (1984) seemed to have forgotten where oysters actually grow! Yet the oceans play a critical part in the world climatic system and cursory reading of the national curriculum suggests they are neglected everywhere, and almost totally neglected within the geography syllabus."

[36]The directors of the German Sea Observatory wrote an article, "The Magnificent Twilight Manifestations in the Period from 26 to 30 November, 1883", when Krakatoa began to have effects on the sky in the northern hemisphere three months after the eruption; Neumayer, op. cit. (Footnote 1).

By maintaining an observational standpoint aimed at the atmosphere and ruled by statistics, it is possible that a whole series of opportunities to describe concretely the mechanics of the global natural system under unusual circumstances have been allowed to slip by. This will be shown in the following examples, as they could play an important role in describing the climatic situation. The nature of this paper means that these can only be theses. They must be proven in another place. At the same time, it could be of help to localise important points which are essential if climate research and climate protection are to be successful.

2. Krakatoa - A Climatic Once-in-a-Century Event?

a. State of Affairs

In the year following the three volcanic eruptions in 1883, including Krakatoa in August 1883, the circulation in the atmosphere was above normal and then sank to a powerfully developed minimum in 1888, wrote Artur Wagner in his discussion of climatic change in 1940.[37] At the most, a reduction in solar energy could be caused only by fine dust at high altitudes. Other authors also refer to Krakatoa only from the standpoints of blockage of sunlight and as a cause of ice ages.[33] Even today, the discussion of large-scale volcanic eruptions is limited to the determination that it can become colder for a short period of time.[3"3] Little is left of Neumayer's eurphoria of January 1884 and - as it appears - there have hardly been any advances for science. Did Krakatoa really leave behind so few traces, or were they simply not recognized?

b) The Observations after Krakatoa and the Stabiliser

Only a short time after the main eruption of Krakatoa on *21* August, 1883, unusual observations were reported, which were compiled by Neumayer.[AO]

Here are some examples from ship logs from all over the world in 1883:

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[37]Wagner, Artur, op. cit. (Footnote 2), Pp. 41-42.

[38]Cf. Wexler, H., op. cit. (Footnote 2); Bradley, R. S., The Explosive Volcanic Eruption Signal in Northern Hemisphere Continental Temperature Records, Climatic Change, Vol. 12, 1988, Pp. 221-244.

[39]Cf. for example Investigative Committee, op. cit. (Footnote 5), Vol. 1, P. 220; GraBl/Klingholz, op. cit. (Footnote 34), P. 61, write: After a powerful volcanic eruption, "it will become colder for a short period of time, but after a couple of years the disturbance has passed. Only in exceptional cases will there be a natural climatic catastrophe." S. H. Schneider, op. cit. (Footnote *1)*, P. 45, continues (P. 91): Recent theories linking climate and atmospheric opacity from volcanic eruptions are not confirmed and this connection is physically better based." Cf. also Gentilli, J-, Present-Day Volcanicity and Climate Change, The Geological Magazine, Vol, 85, 1948, Pp. 172-175, who denies any connection whatsoever. So does Mitchell, J. Murray Jr., in: Singer, Fred (ed), The Changing Global Environment, 1975, Pp. 149-173 (171).

[40]Neumayer, Report on the Volcanic Eruptions of the Year 1883 with Respect to Their Effect on the Atmosphere, *Meteorologische Zeitschrift,* 1884, Pp. 49-65 (Continuation from previous issue, cf. Footnote 1).

3 September: During the past few days, there has been a fairly even gray cloud mass, normally covering the entire sky, above the cumulus and stratus clouds;
3 September: At midday hazy gray air. Hazy, gray air condensing into dew towards evening;
5 September The air appears yellow and watery;
7 September: The atmosphere appeared to be filled with very small, evenly distributed clouds of vapor;
13 September: The yellowish "haze" continues in the upper atmosphere;
11 October: Fiery atmosphere, cloudless sky;
5 November: Pale atmosphere;
10 December: The air was very clear and looked like the air in the southern Indian Ocean during the typhoon season;
13 December: Lead-colored sky.

The observations were continued, collected, evaluated, and thoroughly discussed.

Five years after the eruption of Krakatoa, the scientific work on the events of the year 1883 were temporarily brought to a close with the "Report of the Krakatoa-Committee of the Royal Society." A summary by J. M. Pernter was given in the *Meteorologische Zeitschrift* of 1899. The following information is derived mainly from this summary."[1]

The most amazing aspect of the report is that it does not contain any mention of possible relevance of the oceans. Furthermore, the question of a possible change in the average temperature of the atmosphere does not appear to have interested anyone. Although it was quickly determined that the amount of solar energy received was clearly reduced for a period of several years, little attention was paid to the development of the atmospheric temperature. The blockage must have fluctuated strongly and have varied greatly, depending on the observation point. In total, the blockage effect has been calculated at an average of approximately 10% over *a* span of four years, whereby the reduction of solar energy in the northern hemisphere (Paris) was at its greatest in fall of 1885, reaching a value of 25%."

It would seem that a reduction of solar radiation of such proportions would necessarily have a long-lasting effect on atmospheric dynamics. But supposedly the average temperatures fell only slightly'[43] and the atmospheric circulation in 1884 was above normal and did not sink to a

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"Pernter, J. M., The Krakatoa Eruption and the Resulting Phenomena, *Meteorologische Zeitschrift*, 1889, Pp. 329-339, Pp. 409-418, Pp. 447-466; cf. Neumayer, op. cit. (Footnote 1), P. 3, concerning the beginning of work by the Committee of the Royal Society in London.
[42]Cf. Wexler, op. cit. (Footnote 2); Pernter, op. cit. (Footnote 41), P. 412.
[i3]Cf. Gentilli, J., op. cit. (Footnote 39). According to the graph reproduced in "Protection of the Earth", op. cit. (Footnote 5), P. 194, a drop in temperature cannot be determined, but is mentioned on page 220. On the corresponding graph from the IPCC report (Ja'ger & Ferguson, op. cit. (Footnoe 12), P. 72), it is at least mentioned that this is the avera^i" temperature measured over land.

strongly developed minimum until 1888." While the equilibrium of the world of statistics may not have been disturbed by Krakatoa, events were rather different in the world of nature. Without the stabilizing effects of the ocean, the effect of Krakatoa would have been catastrophic. A person sitting in warm bath water does not experience any discomfort when the heating is turned off - at least, not right away. But what can possibly happen to the higher latitudes of the earth if the warm water from the tropics is already on the way? A cooling-off effect will only become noticeable after the passage of some time and continued blockage of solar radiation. The influence of the oceans was shown clearly by the fact that coastal areas had above-average temperatures in 1884, whereas continental land masses such as Russia, Siberia, India, China, Canada, and the USA (inland areas far from the Atlantic) recorded very cold winters in the years up to 1888.*[5]

This could be dismissed as coincidence if the time until 1886 had not been accompanied by another phenomenon, a "hazy fog", a strange, smoky cloudiness in the atmosphere which was observed both in the tropics and in other areas. When Pernter further states (P. 410): "The hazy fog appears as a constant companion of the extraordinary optical phenomena in the atmosphere during the entire period of the atmospheric-optical disturbance," then one can say - speaking non-technically - that Nature had "popped a lid over it" and so protected the oceans from cooling off too quickly. The lid consisted of ingredients provided by Krakatoa and water vapor provided by the ocean. As a result of the "dirtying" of the atmosphere by the volcano's eruption, the atmosphere displayed characteristics and behavior deviating from the norm. Just as fog over a water surface sharply limits the transfer of heat energy, the hazy fog must have had a long-lasting effect. The dispute at the time as to whether Krakatoa had provided the water vapor (Pernter, P. 414) would most likely not have occurred if it had been assumed that the upper ocean water level (statistically speaking) was about 30° C. warmer than the atmosphere. The fact that the air circulation did not reach its minimum until 1888 is not surprising. From the middle of the 1880s on, a "weakening" of the oceans in the higher latitudes must have become noticeable. The less heat energy the ocean feeds into the atmosphere, the weaker become the dynamics in the atmosphere. This also becomes clear when it is seen that three years after Krakatoa the temperatures above land rose more sharply than above the oceans.[Ae]

c) The Missed Opportunity

If climate is explained by average weather conditions and the oceans are

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[44]Wagner, Artur, op. cit. (Footnote 2), P. 42.

[45]Gentilli, J., op. cit. (Footnote 39), Pp. 173-174. The following general observation of W. Weischet, op. cit. (Footnote 27), P. 70, could be taken into account as an inverse conclusion, according to which the northern hemisphere receives about 10% less shortwave energy than the southern hemisphere. It should be considered that the southern hemisphere came under the "blockage" 2-3 months earlier and presumably more strongly (it was never measured) than the northern hemisphere.

[46]Cf. Jones, P. D., Wigley, T. M. L., & Wright, P. B., Global Temperature Variations Between 1861 and 1984, Nature Vol. 322, Pp. 430-434.

allowed only a static place in events in Nature, as was the case until recently, then we really could go on with our daily affairs and regard Krakatoa as no more than an interesting event in Nature which gave us some beautifully dramatic sunsets. But when the oceans temporarily cool off, it does not mean that heat is withdrawn in equal measure everywhere from the upper ocean layer. As the oceans comprise a chaotic system,[A7] it must be assumed that the tendencies in the entire system change when an event such as the eruption of Krakatoa takes place and has an effect over a period of three to four years. The fact that the sum of the statistical values (particularly the global average temperature) showed little or no deviation cannot be proof that the event did not have any climatic quality whatsoever. An event which reduced the solar radiation by about 10% for more than three years cannot have failed to influence ocean currents and must have had to one extent or another short- as well as long-term consequences. In addition, the possibility that the oceans reacted in some way to a three-year "cleaning of the sky" of volcanic ash, pumice dust, and sulfuric acid, more than 2/3 of which landed in the seas, cannot be categorically excluded.

After the eruption of Katmai in 1912, the temperatures in the low and middle latitudes also rose by up to 1° C. and even more in the higher latitudes. Wexler of the US Weather Bureau wrote of this in 1951: The warming in the middle and lower latitudes can be *a* result of clearer air and increased transport of solar energy, but the warming in winter in higher latitudes during the Arctic night will have to be explained in another way.[Aa] Naturally, someone should have thought of the oceans.

3. The Events from the Depths

a) The Event from Nothing - The Cold Period 1940 - 1965

It is a fact that a notable warming period began in 1920, which in 1940 changed into a cooling-off period lasting until about 1965. Referring to this, the German Parliamentary Investigative Committee (1990) had nothing more to say the following explanation:
"Unusually great temperature increases were observed in the northern hemisphere in the 1920s and in the 1980s, during which the average temperature rose by more than 0.1" C. per decade. This great temperature increase is balanced by a cooling off of the ground-level air masses of about 0.4" C. between 1940 and 1965. These great temperature fluctuations, limited to the northern hemisphere, are attributed to the interaction of various climate parameters which are particularly strong over the continents and thus in the northern hemisphere."[49]

[A7] Cf. Curt Covey, Chaos in Ocean Heat Transport, Nature, Vol. 353, 1991, Pp. 796-797.

[i8] Wexler, H., op. cit. (Footnote 2), P. 14.

[49] *Op.* cit., (Footnote 5), P. 195. If this statement is compared with the graph on page 194, then it is striking that the downward trend in the southern hemisphere after 1940 is sharper than in the northern hemisphere. Cf. also Folland et.al., Worldwide Main Temperature Fluctuation, Nature, Volume 310, 1984, Pp. 670-679. Folland & Parker, in: Schlesinger, M. E. (ed), Climate-Ocean Interaction, 1990, Pp. 21-52.

The reader is allowed to guess what these “various climate parameters” might be. J. Murray Mitchell becomes more concrete when he states: The warming of the global climate during the 1920s and 1930s can in part be explained by the fact that during this time there were no volcanic eruptions, whereas the cooling-off, which reached its zenith in the 1960s, can be explained by a renewal of volcanic activity, including the giant eruption of Agung in 1963.[so] But Mitchell's explanations only serve to make the confusion complete. Agung was the first large volcanic eruption in a long time, Agung is in Indonesia, and in 1963 the cold period was almost at an end. Furthermore, the cold wave in 1940 came abruptly.

b) The 1940 Event from the Depths of the North Atlantic

In 1940 and the following years, the North Atlantic, particularly from the Norwegian coast to Iceland and up to Spitzbergen was the location of countless underwater explosions and extensive sea battles.'[1] Although enormous amounts of explosives were also set off under the ocean's surface in the Pacific, the sea area south of Spitzbergen, where the waters of the Gulf Stream flow over difficult seabed terrain into the deep oceans, is particularly sensitive to disruptions.[52]

Considering the significance of the Gulf Stream for heat conditions in the northern hemisphere and in Europe in particular, it is surprising that no one has looked into the influence of conducting war at sea on the temperature drop beginning in 1940. The origin of this thought is the fact that only a very thin upper layer of the oceans displays high temperatures, while *75%* of the oceans' water is colder than +4° C.

In general, water temperatures fall as depth increases. If warm surface water is exchanged with that from lower water layers, the "bath water effect" of the ocean water must decrease and the temperature of the air above it will also fall. On the other hand, the "heat which has been pushed into the depths" must some day come up again, and then the

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[50]Mitchell, J. Murray, in: Oliver, John E., & Fairbridge, Rhodes W. (ed), The Encyclopedia of Climatology, New York, 1987, P. 326.

[51]ln World War I, for example, over 300,000 blockade mines and in World War II over 800,000 mines were laid; cf. Monin, Tsymbal, Schmelev: Damage to the World Ocean as a Result of the Armaments Race, in: Peace to the Oceans, Newsletter 2-90, Pp. 26-29.

[52]For details, cf. Aagaard, Knut, in: Parker, S. P. (ed), McCraw-Hill Encyclopedia of Ocean and Atmospheric Sciences, 1980, Pp. 21-26; among other factors, Aagaard refers to the importance of the salt content. This was recently described in expositions by Walter Frese on NDR 3 on 1 August, 1992, "Ocean Salt: Anti-Freeze for Europe"; *Hamburger Abendblatt*, 22/23 August, 1992, "A Pinch of Salt Makes the Difference"; *Siiddeutsche Zeitung* on 27 August, 1992, "How the Oceans Determine the Climate". Note: Salt content plays a major role everywhere in the oceans, and changes have decisive effects. If the Strait of Gibralter, through which the North Atlantic receives its high salt content, were blocked up, it would not be long before the ice line would be at Scotland. For an explanation of the "flow mechanism" between Iceland and Greenland, cf. Whitehead, John A., Giant Ocean Cataracts, Scientific American, Vol. 260, 1989, Pp. 36-43.

average measured air temperature will rise more than expected. This could explain the greater temperature rise since the beginning of the 1970s. For all of the heat held by the oceans under the surface remains stored until it is transferred to the atmosphere. In addition, there must be effects on current relationships from extensive underwater explosions. In the North Atlantic, all the way up to the Barents Sea, any disruption can have a particularly powerful effect.

c) The Warm Period Beginning in 1920 - Result of World War I?

In 1920, a warming period began rather abruptly. It was found that in the peripheral regions of the northern Atlantic (and only in the Atlantic) the water temperatures suddenly began to rise strongly as of 1920. These conditions continued in the waters off Greenland until about 1930 and around Iceland and north of England until early 1940.[s3] Optically, the change could clearly be seen in an unusually extensive withdrawal of the ice line in the Barents Sea as of the beginning of 1920, reports Wagner.[5A] He also points out that in the years between 1912 and 1918 there was a median deviation from the average water surface temperatre in the Barents Sea of -0.7° C., but that in 1920 the deviation was almost +1° C., which is a temperature increase of +1.7° C. within a very short period of time. The following quote from Wagner is also interesting:
"Finally, Scholasky notes that the warming of the polar area began in 1921 and writes: The branch of the North Atlantic current which enters the Arctic Ocean at the edge of the continental shelf near Spitzbergen, has so increased in strength that the covering layer of cold water which at Nansen's time was 200 m thick has not been reduced to less than 100 m."[55]

It was not necessary to wait for the explosive fire power of the Second Word War to create "disorder" in a surface layer of several dozen meters. The sea war in the North Atlantic from 1914 to 1918 was more than just a few skirmishes. As it is clear that during this time there was a drop in the average air temperatures, it is possible that this was caused by the water exchange described above. In addition, the water explosions could have had such an effect on the ocean current conditions that there was a long-term warming of the northerly part of the North Atlantic and the Barents Sea.

d) The Undiscovered Chance

Neither in 1940 nor in 1918/20 was there an atmospheric occurrence which could explain the temperature fluctuations for the periods from 1920 to 1940 and from 1940 to 1965. There were no large volcanic eruptions. CO_2 cannot

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"Bjerknes, J., The Recent Warming of the North Atlantic, in: Bolin, Bert (ed), The Atmosphere and the Sea in Motion, Oxford, 1959, Pp. 65-73. Cf. also Wagner, A., op. cit. (Footnote 2), P. 49.

"Wagner, Artur, op. cit. (Footnote 2), Pp. 46-47, who also gives information about the mediation deviation (D) of the ice line (in km) in the East Spitzbergen Sea for late summer of the years 1898 to 1934, e.g.:
1914 = D +120; 1915 = D +30; 1916 = D +320; 1917 = D +100; 1919 = D -30; 1920 = D -140 (all other values through 1934 are also minus).

[ss]Wagner, Artur, op. cit. (Footnote 2).

be the cause of the cold period. But because of the suddenness of the change, the greenhouse effect cannot be a direct cause of the warm period, either. There is also very little place for a significant indirect involvement. It was determined that in the Barents Sea the warm water masses expanded from the depths to the surface, i.e., the 0° isotherm moved upwards.[36]

In conclusion, it should be noted here that the climate changes of 1920 and 1940 can be evaluated only when the two sea wars of this century have been thoroughly investigated with respect to their relevance for the climate.

4. Other Events - Constant Dropping Wears the Stone

a) Poisoners of the Sea

This was the title of an assessment of the condition of the oceans published by K. A. Gourlay (London 1988)." But neither he nor other scientists have considered the influence of the enormous ocean pollution on the heat relationships or on the relatonships among the ocean currents in particular. If serious thought is given - and this is undoubtedly necessary - to the fact that emissions into the atmosphere can cause a shift in the natural equilibrium of nature, then the industrial influence on the dynamics concentrated in the oceans can most certainly not be ignored. The sinking process of the Gulf Stream in the northeast Atlantic could in the long run also be affected by the water from the North Sea or or other ocean pollution, whether with or without the pinch of salt which has recently become a topic of discussion (cf. Footnote 52).

b) Eight Times a Day to the Moon - Warming in the Wake?

It was described above how every exchange of water between upper and lower layers can have very sudden effects. There are over 30,000 trading ships registered. If half of them travel about 275 nautical miles (about 500 km) every day, then the waters of the oceans are "churned up" to a width of about 30 meters and a depth of about 15 meters over a path which is equal to eight times the distance from the earth to the moon or 1500 times the distance from the English Channel to the east coast of North America (all of these figures rough estimates). In a year, this would mean that the Atlantic from Iceland to the Ross latitudes is "plowed up" to *a* depth which contains as much heat capacity as the entire atmosphere. As a general rule, warm water is exchanged for cold in this process.

No one can say today what really happens and what the effects are. There are virtually no series of measurements which would permit acceptable conclusions about the isotherm structure and its development over a long period of time for the upper layer of the ocean to a depth of at least 50 meters. An on-location investigation series (apparently one of the first) by

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[56]Cf. also the references given by Wagner, Artur, op. cit. P. 49.
[37]Cf. also GESAMP, The State of the Marine Environment, UNEP Report 115, 1990; OECD, The State of Environmnet, 1990 Pp. 71-93.

Caspar (among others)[58] showed - although in general it was no secret -that the temperature difference between the surface and a depth of 15 meters can amount to more than 3" C. When there is a mixing, the surface temperature can sink by 1.5" C. In the long term, this can cause a warming of the ocean surface and thus an increase in the air temperature.

It would be nice if it could be proven that there is no effect on the climate resulting from the wakes of the world's trading fleets. But it cannot be excluded, and this effect is just as much in need of clarification as the greenhouse theory.

III. CO_2 - Drastic Effect or Drastic Exaggeration?

Bitter and confusing, the debate over the greenhouse sheds more heat than light. The science is shaky but there's reason to act anyway, commented *Newsweek* on the start of the Rio Conference in June 1992." Such criticism is rare so far. Ruling opinion is convinced that the steps taken in Rio point in the right direction.[60]

It would be absolutely impossible for this paper to take up a full survey of the contributions to the topic of greenhouse gases. It also does not intend to suggest that the greenhouse gases have nothing to do with the warming process, just as the "butterfly effect" for events in nature's systems is not being called into question here.[61]

However, the dimensions of the standards on which these statements are based should be questioned. This question was in principle mentioned above in the section on statistics. Of course the emissions of greenhouse gases are a more concrete danger than the flight of millions of butterflies. Even if an otherwise dry layer of air completely filled with greenhouse gases experiences a temperature drop of about 20° C. per hour after sunset, the concept itself cannot be completely negated.[62]

Nonetheless, there are reasons, from a climatic viewpoint, which justify doubts in granting CO_2 (as well as other greenhouse gases) a prominent

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[3S]Gaspar, Phillipe, Andre, Jean-Claude, & Lefevre, Jean-Michel, The Determination of the Latent and Sensible Heat Fluxes at the Sea Surface Viewed as an Inverse Problem, Journal of Geophysical Research, Vol. 95, 1990, No. C9, Pp. 16.169-16.178. "Newsweek, 1 June, 1992, P. 20.

[60]The Int. Herald Tribune (New York Times) 16 June, 1992: "Rio Sketched the Road" (But now, after the Earth Summit, there is a road); The Guardian, 15 June 1992: "Rio: the Bucks Stop Here" (Rio has set up some machinery for effective cooperation); Financial Times, 15 June, 1992: "Many Roads from Rio" (The Rio conference was worth having - once). [61]The meteorologist Eward Lorenz published a paper in 1972 with the title, "Can the Beating of a Butterfly's Wings in Brazil Cause a Tornado?", cf. Palmer, Tim, in: Hall, Nissa (ed), Guide to Chaos, London 1991, Pp. 69-81.

[62]The possibility that the CO_2 thesis could be a flop is mentionened in: Newsweek, 1 June 1992, Pp. 23-24. Excerpt: "Greenhouse theory suggests that warming should peak on summer afternoons: the worst time, . . . Karl's (of the US National Climatic Data Center) work suggests nature is doing the opposite."

place in the efforts to protect the climate, e.g., the following:

1. Atmospheric dynamics come about principally from the varying concentrations of heat. While water vapor has the characteristic of appearing in various concentrations throughout the atmosphere, CO_2 is distributed evenly. To this extent, it is a substance which is neutral for the climate and can appear of importance only indirectly in connection with water vapor. The following explanations refer to this:

a) Figuratively speaking, the distribution of the greenhouse gases can be compared to a gridiron whoses meshes are the same distance apart. The only variable is that the mesh network can be drawn tighter (e.g., by more CO_2) or loosened. This net, by the way, changes only in accordance with the seasons and never by more than 1-2/S.

b) Water vapor, on the other hand, appears in varying concentrations. A saturated cloud has stored within a certain volume many, many more times the amount of energy as the same volume of the gridiron. A hurricane, which derives its energy from the ocean, produces about 300-400 billion kw-hours daily and releases 10-20 billion tons of water.[6TM1]

While there is a active exchange of water and energy between the ocean and the atmosphere,[6"] the greenhouse gridiron does not change.[63] It would be interesting to know how many kw-hours and how many tons of water the greenhouse gridiron contributes to a hurricane as it develops and moves through a region. As the development, strength, and maintenance of a whirlwind is dependent on the condition of the ocean, such as in the case of a hurricane, it seems unlikely that the greenhouse gridiron makes a significant contribution - except perhaps in computer simulations - to this process.

c) To this extent, it is difficult to understand how any significant amounts of heat energy could be transferred from this gridiron to the ocean, thus leading to a rise in the level of the seas. Practical experience all shows that when the air is dry the land heat does not come from the air, and when warm air encounters cold water, the ocean immediately protects itself with a protective shield which can sometimes be recognized as fog. Admittedly, the interaction between ocean and atmosphere requires persistence if it is to be explained plausibly. But it is a mystery how anyone can explain with any conviction that the seas can be heated by a cloudless sky at night, for example. The oceans will steam up any argument, just as the bath water steams up the air in the bathroom.

2. More important than the arguments above is the starting point for the greenhouse debate. Put simply, it can stated thus: Because the concentrations of the greenhouse gases and the air temperatures are rising, there cannot be any serious doubt that these events are somehow

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"Gross, M. Grant, op. cit. (Footnote 26), P. 119.

[6A]A series of other factors which cannot be discussed here, such as plankton, salt, dust, and particularly the direct effect of the solar radiation on the oceans, also play a significant role in this process.

[65]For example, it was mentioned in *Umwelt-Weltweit,* Report of the UNEP 1972-1982 (Volume 88A - Discussions of Environmental Development), P. 53, that the CO? effect appeared to act differently than had been expected.

connected. To emphasize this, reference is made to the rising level of the sea, the series of warm summers, and the rising intensity of weather events.[66]

Viewed by a seaman, the following questions would come to mind: Are the air temperatures rising because the ocean is warming for reasons other than those attributed to CO_a, causing the oceans to expand, the level of the sea to rise, the recording of warm summers, more intensive occurrence of atmospheric activity, changes in ocean currents, a more frequent appearance of El Nino, the expansion of desert regions, etc. Unfortunately, there is no answer to this question. Just as one hundred years ago, the oceans are still a climatic frontier.

Although a widespread basic awareness of the particular role of the oceans is present, they remain for many people, for reasons which are difficult to understand, "very far away," as if we were talking about the "obvious" which did not need to be investigated in any more depth.[67] Even the marine biologist Rachel Carson, whose book **Silent Spring** is unquestionably one of the most famous (and one of the first) environmental books, does not award the oceans a prominent position[68]. Only singly and hesitantly is mention made "here and there" that more attention must be paid to the oceans[69].

Only recently have clear warnings been heard. John Spiesberger of Woods Hole Oceanographic Institution declared in April of this year at the convention "Oceanology International 92" in Brighton: "We won't understand global warming until we understand exactly how important a role the oceans play."[70]

IV. The Phenomenon - Climate

1. The Statistical Starting Point

[6S]Cf. Ja'ger & Ferguson, op. cit. (Footnote 12), there: Bollin P. 19; Houghton, P. 23; others as well. Cf. also GraBl/Klingholz, op. cit. (Footnote 34), P. 14.

[67]This phenomenon could be labeled "continental thinking", which would include the weather. To this extent, meteorology has to this day not been able to free itself from a "land consciousness."

[6M]As an example of this attitude, cf. the following sentence from the report of the UNEP 1972-1982, op. cit. (Footnote 65), P. 25: These experiments indicate that regions in the ocean may have a significant influence on atmospheric processes over the land - with a temporal shift of 4-8 months. Cf. also, for example, the speech held by the great man of the sea, Jacques-Yves Cousteau, before the UNCED Full Assembly on 4 June, 1992, in: *Die Weltwoche*, 11 June 1992, P. 63.

"'[J]E, g., Svendrup, H. U., Oceanography for Meteorologists, New York 1941, P. 223 (. . . one cannot deal independently with the atmosphere . . . but in meteorology it has not yet received sufficient attention). Namias, J., The Sea as a Primary Generator of Short-Term Climatic Anomalies, in: WHO Proceeding on Long-Term Climatic Fluctuation, Norwich 1975, Pp. 331-333. Clay ton, Keith, op. cit. (Footnote 35).

[70]The Guardian, 10 April 1992, Booth, Nicholas, How to Tune into an Ocean Wave.

It is noteworthy that in the climate debate so far the oceans have been granted only a peripheral importance, which leads to the question, "why". Thp forefathers of the greenhouse theory, such as Svante Arrhenius and the mathematician Plass (Footnote 3) attempted to explain the beginning of the ice ages on the basis of rising CO_2 concentrations. They displayed no recognizable interest in the function of the global natural system.[71] Even the Second Climate Conference in Geneva in 1990 and the preparatory negotiations for the Rio Conference could not yet extract themselves from this abstract observation method. Without the least hesitation or doubt, greenhouse experts use the definition provided to them by meteorology: Climate is the average weather over a long period of time.[72]

As a result of this definition from the last century, climate has been only of secondary interest for meteorologists, seeing as how it meant no more than adding up all the collected observations for a given period of time and a given region and dividing this figure by the number of years involved."

It was not until the middle of the 1970s, when the danger to the ozone layer caused by CFCs entered the discussion, that meteorology began to show an interest in chemical processes in the atmosphere[7A] and to make extensive use of computers and the new world of statistics. The definition of climate from ancient times fit like a glove. A rejection of a climate concept based on statistics did not take place; in fact, it was just the opposite. The "dry-as-dust bookkeeping" (Footnote 73) was transferred into the fascinating world of computer model simulations. It is truly astounding how credible science has been in accepting the evidence and proofs provided by this aid. Yet it is nothing more than a continuation of the recording of statistical values once used as a basis. Even if it could be assumed that all the relevant basic data for the oceans had been entered (which is considered impossible), the natural system is still too variable, complex, and chaotic for computer models to be able to provide a reliable extrapolation. The US Environment Protection Agency (US EPA) also took

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[71]In this respect, and as an indication of the attitude of meteorology, cf. Lamb, H. H., The New Look of Climatology, Nature, Vol. *223,* 1969, Pp. 1209-1215: "But for the physical scientist it has seldom had a depth of interest to rival dynamical meteorology and the great strides forward in the development of numerical forecasting."

[72]Cf. Houghton, J. T. et al. (ed.), Climate Change, The IPCC Scientific Assessment, Cambridge, 1990, P. XXXV; Harries, John E., Earthwatch -The Climate from Space, Chichester UK, 1990, P. 30.

[73]Cf. Lamb, H. H., The New Look of Climatology, Nature, Vol. 223, 1969, Pp. 1209-1215 (1209): "Climatology was generally regarded as the mere dry-as-dust bookkeeping end of meteorology."

[74]GraBl/Klingholz, op. cit. (Footnote 34), P. 90. One of the "greats" (and until recently a critic of the greenhouse debate, cf. Andresen, op. cit. (Footnote 11)) in climatology, S. Fred Singer, came up with the following statement about climatic influences in 1975: "The four most important factors are: chemical changes in the atmosphere, particularly changes in CO_2 concentration; presence of dust and aerosols; changes in surface albedo, including ice and snow, clearing of land, inundation, building of cities, etc.; and generation of heat." In: Singer, S. Fred (ed), Introduction, op. cit. (Footnote 39), P. A.

this stand in a report to Congress in 1989.[75] Speaking of the atmosphere, the former English Prime Minister, Lady Margaret Thatcher, who was educated as a chemist, also denied that the natural system could be researched in a laboratory.[76]

2. What is Climate - The Place of Climate in the Natural System

The present climate discussion is being held because there is serious reason to fear that there could be changes. As this would result in shifts and changes of weather conditions, it would seem to be self-evident that climate cannot be defined as the result of average weather conditions. Climate is a cause of weather and not its result. This reversal of cause and effect has blocked the way for a suitable treatment of the climate problems in the climate discussion so far.

Even if climate is used only as the term for the description of a current set of circumstances, this assumes that it be defined in a way which clearly refers to its causal nature. The definition of climate used so far does not satisfy this condition. For one, it takes into account only a partial aspect of the global natural system - the weather - and, for another, ignores the dimensions of the influential and decisive forces within this system.

An event such as Krakatoa, the cooling off in 1940, but also the generally known statistical ratio data concerning the heat energy levels of the earth indicate that process here under discussion can be defined as follows: Climate is the continuation of the oceans by other means. If we wish to avoid this paraphrase of Clausewitz' famous declaration[77], a reliable definition of climate is, with some restrictions, only possible if it permits us to see immediately that the oceans play a central role in determining

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[75]Smith, Joel B., & Tirpatz, Dennis (ed), The Potential Effects of Global Climate Change on the US, US EPA, December 1989, P. 21: "In many sciences ... it is possible to investigate new phenomena by doing research in a laboratory. In the field of climate, this is not possible. One cannot bring the earth's climate system into a room and perform experiments on it, changing the trace gas concentration or increasing the amount of sea ice. It is not possible to have two identical systems, one a control that is changed to compare the outcomes."

[76]From a speech held on the occasion of a "Royal Society Dinner" on *27* September, 1988: "In studying the system of the earth and its atmosphere we have no laboratory in which to carry out controlled experiments. We have to rely on observations of natural systems." Cf. also Lamb, H. H. op. cit. (Footnote 73), P. 1215: "The computer models of atmospheric behaviour in other climatic eras may be too unrealistic, and may therefore proceed too far and too fast on faulty basic assumptions." Cf. also Peterman, R. M., et al, Statistical Power Analysis and the Precautionary Principle, Marine Pollution Bulletin, Vol. 24, 1992, Pp. 231-234, with further references; Ghan, Steven, J., The GCM Credibility Gap, Climate Change, Vol. 21, 1992, Pp. 345-346, according to which there are great discrepancies between the results of various GCMs regarding the greenhouse warming.

[77]"War is the continuation of politics by other means."

climate.[73] Climate is not itself a cause, but arises from the condition and the effect of the oceans on the atmosphere.

This becomes particularly clear in areas where cold water from the deep oceans rises on the edges of continents, such as in Chile and Namibia. Here, the waters of the ocean assure that climate and weather are identical. A further example is the climatic categorization of the poles. In general, these ice masses are "deep-frozen" climate. While not wishing to question their relevance for the daily atmospheric influence, their particular climatic significance is based on the release of melting water (cold fresh water) into the oceanic system.

3. Further Points of Argument - Further Question Marks

Other points also play a role in the discussion of climate. Some of them should be mentioned briefly here.

a) Climatic Data from Prehistoric Times

There is some doubt as to whether even good research results on the climate in the past (e.g., during the ice ages) are of any particular help for the problems of today. The conditions of the ocean do not repeat themselves. The historical condition of the oceans at a particular time or time period cannot be reconstructed with an exactness which would in any way be of help for the present-day situation. Even if this were possible, it is difficult to see how this would be of any use in overcoming the present climatic problems.[79] After all, we must look for and stop the processes by which industrial society interferes in the "natural" course of events. The way the oceans have reacted for centuries or even longer becomes irrelevant for this question.

b) The Chicken or the Egg - Atmospheric Winds and Ocean Currents

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[7s]Klaus Hasselmann, Ocean Circulation and Climate Change, Max-Planck-Institut fur Meteorologie, Report No. 58, 1990, P. 3, stated: "The dynamics of climate is strongly controlled by the ocean," but only allowed for an influence of the oceans over a period of time of a few weeks up to a thousand years. In Report No. 57, P. 8, a reaction time of hundreds up to a thousand years for the oceans is allowed for "external forcing." It is not made clear that the oceans "bear", second by second, the climate or the air temperature. Eric B. Kraus in: Oliver & Fairbridge (ed), op. cit. (Footnote 33), P. 639, also declares: "The ocean is truly the flywheel of the climate system," but then hedges. But the trend - albeit very slowly -is moving towards the oceans, cf. Stephens & Slingo, who recently wrote: "With the oceans assuming an ever greater significance in our understanding of climate, ..." in: Nature, Vol. 358, 1992, P. 369. "Particularly when it cannot be seen that logical conclusions have been drawn. There is a lot of discussion about the fact that climatic changes could be caused by changes in currents in the deep ocean (cf. Watts & Morantine, Rapid Climatic Change and the Deep Ocean, Climatic Change, 1990, Pp. 83-97), but no one pays any attention to the possible effects of polluted river water and many other factors on the ocean currents.

The previous discussion is dominated by the idea that climatic changes will have an effect on the oceans. The thought that the danger should arise and be determined by the oceans has found little support[80]. An example of this line of thought can be seen in the literature, which often indicates that the currents in the upper levels of the oceans are caused by winds[81.] As the last link in a chain of causes, the winds are certainly of importance. However, the earlier causes in the chain, i.e., the condition of the ocean or of an ocean region are much more decisive. Based on the former viewpoint, it would be difficult to explain the frequency of occurrence of El Nino with changes in the atmospheric wind conditions."[2] But this is done by stating that the winds had changed due to a warming of the atmosphere. El Nino is a phenomenon from the depths of the ocean, and the atmosphere follows its direction.

c) The Rise in the Level of the Sea - Cause from Above or Below

The rise in the level of the seas has played a major role in the discussion, as it underlines the dramatic nature of the climatic changes. In addition, it is used as evidence to prove that the greenhouse age has already started. The idea that the oceans could be expanding because a warming not initiated by the condition of the atmosphere is originating in them has not yet been a topic of discussion. Written material has been concerned either with the collection of data of water mark measurements or with determining the expansion coefficient of water masses, dependent on the assumption of various degrees of warming. As far as can be seen, little thought has been given to the question of how the layers of ocean water (to a depth of 20, 100, or 500 meters?) could be warmed by the atmosphere. This is simply assumed.[83]

[e°]Cf. Bernal, Patricio, Consequences of Global Change for Oceans, Climate Change, Vol. 19, 1991, Pp. 339-359.

[B1]Cf. Wunsch, Carl, in: Houghton (ed), The Global Climate, op. cit. (Footnote 32), P. 195; Kennish, Michael J., Marine Science, Bocan Raton, 1989, P. 4: "Ocean circulation is inextricably linked to the atmosphere. Winds and density differences which drive circulation in the ocean largely depend on atmospheric conditions."

[82]Cf. for El Nino: Glantz & Katz & Krenz, Climate Crisis, UNEP/NCAR 1987.

[s3]Cf. GESAMP, op. cit. (Footnote 57), P. 80; van der Veen, C. J., Projecting Future Sea Level, Surveys in Geophysics, 1988, Pp. 389-418; Wigley, T. M. L., & Raper, S. C. B., Implications for Climate and Sea Level of Revised IPCC Emissions Scenarios, NATURE, Vol. 357, 28 May, 1992, Pp. 293-300; the same in NATURE, Vol. 330, 1987, Pp. 127-131; Smith & Tripatz, op. cit. (Footnote 75), Pp. 123-147; Oerlemans, J., A Projection of Future Sea Levels, Climatic Change, Vol. 15, 1989, Pp. 151-174 (165); Elsom, Derek M., Atmospheric Pollution, Oxford 1992, P. 162. For heat from the deep ocean, cf. the report of Roemmich & Wunsch, Apparent Changes in the Climatic State of the Deep North Atlantic Ocean, Nature, Vol. 307, 1984, Pp. 447-450; Rind & Chandler, Increased Ocean Heat Transports and Warmer Climate, Journal of Geophysical Research, Vol. 96, D4, 1991, Pp. 7437-7461; cf. also quote of Wagner (Footnote 55 above).

d) Temperature measurements – Land and Sea

Although there are interesting differences between temperature measurement series on land and at sea (whereby the maritime data is more than scarce as it is), a trend to pass over these differences can be observed.[84]

e) Beginning of a Warm or Cold Age

In the primary occupation with the greenhouse effect as an atmospheric problem, one aspect tends to be given short shift: even if the global-warming theory should prove to be justified, it will not necessarily have such a great effect. Even slight shifts in the ocean currents,[ss] however, can quickly bring about conditions which will remind people that the oceans have an average temperature of only 5° C.

Summary

The examples given above are meant to indicate that many of the contributions to the discussion and the work done in this area show that the independence and importance of the oceans have not been shown adequate consideration. One of the reasons for this is presumed to be the fact that until the second half of this century, science studied climate only as a question of statistics and was otherwise involved, at first with "feeling" and later with the memory capacity of computers, in improving weather forecasts. Even after three decades of use of these aids, the results have been mediocre, to say the very least. This will not be surprising when one considers that the weather is dependent on the

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[84]Cf. Jones, E. D., Wigley, D. M. L., & Wright, P. B., op. cit. (Footnote 46), Wright, Peter B., Problems in the Use of Ship Observation for the Study of Interdecadal Climate Changes, Monthly Weather Review, Vol. 114, 1986, Pp. 1029-1034; Folland & Parker, op. cit. (Footnote 49). Cf. also GraBl/Klingholz, op. cit. (Footnote 34), P. 196. Folland & Parker, for example, simply ignored all daytime measurements. A seaman would have outraged. Jones/Wigley/Wright continued to "adjust" the sea temperatures to land temperatures until they could identify the statistical final result as a long-term warming trend. The fact that the small differences might have been much more interesting was apparently not even considered. Under these circumstances, it is hardly surprising that the presence of great eddies in the oceans was not discovered until the end of the 1960s, cf. Robinson, Allan R., Eddies in Marine Science, Berlin 1983, Pp. 3-4, P. 10, and Spill, A. E., Pp. 442-445.

[85]Cf. the following dialogue before the Select Committee on Science and Technology of the House of Lords concerning the Greenhouse Effect, 6th Report, 1989 (HL Paper 88-11), P. 11: Question from Lord Clitheroe to Prof Wigley: "40 years ago, my tutor . . . was saying at that time the probability was that the raising of the temperature would alter the currents of the sea to make the climate of England colder rather than hotter"; the following reply from Prof. Wigley: "I think that is extremely unlikely, although that is one of those stories that still crops up every now and again in the press" (referring to the work of Wigley, cf. Footnotes 46 and 83).

climate, the climate on the oceans. Without extensive knowledge of the oceans and continual up-to-date and detailed descriptions of the state of the oceans, weather forecasts and climate predictions will continue to be dubious.[86]

Furthermore, the basic factors for the development of the global climate are sketched out in the seas on a time scale ranging from a few seconds to a thousand years. Because of its size, the ocean could be used by humankind as a kind of magnifying glass for long-term tendencies. In addition, it is possibly the only medium which could help us to find causes which are completely unknown today. The establishment and exploitation of a suitable observation network can hardly be carried out without the cooperation and work of all states.

But this requires first of all the understanding that the climate is the continuation of the oceans by other means and that the latter determine how the effects of the civilized and industrialized societies will make themselves felt in the climate.

V. Result - The Situation

The relevant situation for the protection of the climate is closely associated with the oceans. This criterion has not been worked out clearly and adequately, neither in the past nor during the latest discussion of the climate. This has meant failing both to concentrate on the essential nucleus of the climate problem and to mobilize the necessary forces as well as to direct the limited scientific and monetary resources to the central problem.

In speaking of the relevance of the oceans for the climate, it is not adequate that several directed ocean research programs have also been initiated.[87] In order to develop and successfully carry out good practical and legal strategies, the primary need is for recognition and understanding that climate research and climate protection are synonymous with ocean research and ocean protection.

C. Bodies of Regulations for the Climate

I. Climate Convention of Rio - A Beginning?

Through the United Nations Framework Convention on Climate Change,[88]

[s6]This opinion is not exactly widespread. Many scientists seem to have no problem admitting that weather computers cannot provide reliable forecasts for more than a week in advance, as a tiny mistake in the current weather observations can quickly grow to a large one. Nevertheless, they are convinced that the climate computers produce usable results. Cf. Schnei-der, S. H., op. cit. (Footnote 7), P. 93; GraBl/Klingholz, op. cit. (Footnote 34), Pp. 21-22 and Pp. 118-123. Cf. also Footnotes 75 and 76. [B7]Cf. Baker, D. J., World Ocean Circulation and Climate Change: Research Programmes and a Global Observation System, Pp. 195-202, in: Ja'ger & Ferguson, op. cit. (Footnote 12). [B8]This paper is based on an Advance Copy of the Intergovernmental

an international agreement has for the first time taken a direct stand on the climate. It includes 26 Articles and 2 Appendices. The agreement can be sub-divided into the following sections:

- Description of the problems and tasks (Art. 1-3)
- Obligations and tasks (Art. 4-6)
- Measures for supervision and further development of the convention's goals (Art. 7-13)
- Settlement of disputes (Art. 14)
- Administrative regulations (Art. 15-26)

One of the main points of dispute which was fought out towards the end of the two-year period of negotiations between the United States and the "rest of the world"[89] was the question as to whether the agreement should set binding obligations for the reduction of greenhouse gases or only call upon the parties to work towards a reduction. The United States carried the day. Article 4 now establishes that attempts should be made to reduce the greenhouse gas emissions to the level of 1990 by the year 2000. A discussion of further details of the agreement, particularly with respect to the balance between the industrialized countries and the developing countries, follow-up conferences, supervisory mechanisms, or concepts such as "sustainable economic growth and development" canot be discussed here at all.[90]

The question which must be in the foreground is whether the starting point which was chosen in the form of the Climate Convention offers adequate chance of handling the climate problem effectively. This is described in the Convention in the articles on principles (Art. 3) and goals (Art. 2).

Among other things, Art. 3 determines that the parties are to protect the climate system for the benefit of present and future generations. Furthermore, they should take precautionary measures to anticipate, prevent, or minimize the causes of climate change and mitigate its adverse effects.[91] These principles are therefore of a very general nature. The

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Negotiating Committee for a Framework Convention on Climate Change, 15 May, 1992 (A(Ac.237/18(Part Il/Add.l).

"•"Vidal, John, America versus the World, The Guardian, 30 April, 1992; cf. TIME, 30 March, 1992, P. 42; Die Zeit, The Glass House in the Greenhouse, 17 April, 1992; *Der Spiegel,* Festival of Hypocrisy, 21/92, P. 224.

[90]Cf. Beckermann, Economic Growth and the Environment, in: World Development, Vol. 20, 1992, Pp. 481-496.

[9i]Excerpts from Article 3, PRINCIPLES: In their actions to achieve the objective of the Convention and to implement its provisions, the Parties shall be guided, inter alia, by the following:

1. The Parties should protect the climate system for the benefit of present and future generations ... on the basis of equity . . . the developed country Parties should take the lead ....

2. The specific needs and special circumstances of developing country Parties . . . should be given full consideration.

3. The Parties should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects, (cont.)

legal definition of climate change according to Articl 1, No. 2 does little to clarify the situation. According to this, climate change is to be understood as follows:

> "Climate change" means a change of climate which is attributed directly or indirectly to human activity that alers the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods."

Article 2, on the other hand, sets out the actual goals of the Convention, which are then defined in Article 4, Paragraph 2 a) as concrete actions.

> The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level shoud be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner.

The goals as described make it more than clear that it basically affects only the greenhouse gases. The Climate Convention does not make direct use of the traditional definition of climate, according to which climate is the summation of the average weather over a long period of time, but the last half-sentence in "climate change" reverts to the usual statistical basis.

The Convention now uses the concept "Climate System" and defines it in Article 1, Item 3 as follows:

> "Climate system" means the totality of the atmosphere, hydrosphere, biosphere and geosphere and their interactions."

This definition does not make sense. To begin with, it is amazing that the word "system" is used, as climate is neither a thing nor does it consist of material, but is rather a result and phenomenon of other substances. Furthermore, the description of what is meant by climate is so all-encompassing that it would have been enough to write: "Climate system is nature working in all of its forms." A definition which does not serve to make a situation more concrete is not only superfluous, but also allows everyone to interpret it as he may please. Perhaps the only point is to serve as a basis to allow everyone to open his area of specialization for climate research. Even if the present definition now indicates that a change from the traditional definition is taking place, the present description of "climate system" (particularly when this definition is read together with "climate changes") is a sign that the understanding of climate is still vague. The definition points out considerable uncertainty on the part of the legislature and the advisors. But a clear definition of the problem is

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4. The Parties have a right to, and should, promote sustainable developoment. (cont.)
5. The Parties should … promote . . . sustainable econoimc growth.(cont.)

an important first step.[92]

The evident weaknesses in the description as defined in the Convention can hardly avoid having an effect on the following regulations of the convention. According to Article 7, Paragraph a(ii), for example, the Parties are to promote the development and introduction of programs for education and instruction about climate changes and their effects. Since the convention mentions exclusively the greenhouse gases as the only concrete starting point, there is reason to fear that such rules and duties for the the Parties will institutionalize a program of action which will delay and hinder the path to effective climate protection.

Finally, it should be noted that the Climate Convention does not show signs of having encompassed the basic characteristics of the climate problems; the only concrete starting point mentioned is the emissions of greenhouse gases. To this extent, concrete (although not obligatory) measures for the avoidance of emissions have been regulated.

As these requirements do not give the impression that they are adequate for the organization and execution of efficient climate protection, the following considers the problem on a broader basis, referring to the Climate Convention of 1992.

II. Legislature - Science

In spite of Houghton's statement that science and politics had worked together in the climate question in a way that had never been done before,[133] the question still arises as to whether this was not a false conclusion or, if true, if it really served as a substantial help. At the end of the day, the question will be why something worked well or went wrong and who was responsible. One side believes, for example, that international politics and the legal system are too poorly equipped to offer solutions which could ensure the preservation of the earth's climate,[9]" while others see the need to criticize science.[93] In particular, the suspicion has been voiced that some scientists are using the global-warming debate in order to

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[92]"For a true understanding of environmental conflict there must be a true understanding of the environment," writes An Painter, The Future of Environment Dispute Resolution, Natural Resource Journal, Vol. 28, Winter 1988, Pp. 145-170 (150); cf. also Miles, Edward L., Science, Politics & Int. Ocean Management, Berkley, 1987, P. 154.

[93]Cf. Footnoes 9 and 11.

[94]Wirtb, David A., Climate Chaos, in: Foreign Policy No. 74, 1989, Pp. *3-22 (P. 3).*

[95]One (of the few) criticisms of science comes from the developer of the GAIA-Theory, James A. Lovelock: "Science must abandon its genteel posturing and come down to earth again, quite literally. This is no easy task. It requires scientists to recognize that science has grown fat, lazy, and corrupt and, like an obese atherosclerotic man, imagines that more rich food will cure his condition." In: The Guardian, 27 September, 1989, P. 63 (The Greening of Science). Recently, George F. Wille reminded readers that twenty years ago many scientists were predicting an ice age in the near future, in: Int. Herald Tribune, 3 June, 1992, The Eco-Pessimists Among Us Are a Family Bore.

gain influence in the public debate on climate changes.[96] The initial position is certainly complicated. The environmental situation is making international demands for which neither science nor politics are prepared. It could well be that the problems will affect the very substance of man's basis for existence. We still lack the knowledge, international co-operation, and globally binding regulation mechanisms necessary to evaluate, block, or even eliminate the dangers. A particular difficulty arises from the fact that a cost-benefit-analysis of the suitability of the continuation of economic and industrial growth in comparison with the dangers arising from intervention in the natural system is very difficult to carry through. Since a return to the pre-industrial period is out of the question (on the contrary: around three-fifths of humankind are still waiting to beomce part of a modern industrial society), a breakneck balancing act will be difficult to avoid. The principal task for politics will be the development of an effecitve legislative, executive, and judicative, which includes planning, strategies, and enforcement mechanisms.

In any case, this is not the task of science. Categorically, scientists do not enjoy a more favorable position in political decision-making processes than do other interest groups and lobbyists. After all, only proven arguments should become integrated into a political decision-making process. The case of the climate, there is all too often a lack of basic knowledge. In the place of knowledge and logic is faith,[97] and because the scientific argument is lacking, the desire to act directly on the tasks of the legislative is almost understandable.

One cannot help suspecting that science was less interested in making up for lost opportunities (such as Krakatoa, cold change in 19AO, and rethinking the definition of climate) than in first talking, demanding, and intervening in the legislative process, if necessary by overstepping its own limits of authority, all before coming up with definite information. Hypotheses have been put forward without sufficient investigation, and now there is a danger that their supporters will cling to them in spite of considerable doubt on their own part.[98] There is also talk of the "noble

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[96]Cf. Andresen, Steinar, & Ostreng, Willy (ed), International Resource Management, London/NY 1989, there: Young, Oran R., Science and Social Institutions, Pp. 7-2-4 (P. 10); and Boehmer-Christiansen, S., The Role of Science in the International Regulation of Pollutions, Pp. 143-167 (P. 150). "As stated by Michael Haller, Warner, Windmaker, Scientists in *Die Zeit*, *23* March, 1990, including other truly convincing analyses, such as: "As is always the case when exact relationships cannot be discerned and - just as with the tip of the famous iceberg - very little data is known, faith moves in and takes the place of knowledge"; and, "It was scientists . . . who transposed the simple causal models from the laboratory to nature, without taking into account the complex interaction of the various natural processes. They opened the scenario game, the concrete description of calculations; they drew more and more frightening perspectives." [98]Cf. Buttel & Hawkin & Power, , From Limits to Growth to Global Change, Global Environment Change, December 1990, Pp. 57-66 (P. 65): "They have entered the policy arena in an unprecedented way and are now willing to stand behind data that are not entirely conclusive, but which have awesome potential implications for humankind." John S. Gray fears: "There is a risk that the large and powerful WMO will simply ignore the ocean or not give it the scientific priority that it needs in the future." In: Marine

lie",[93] which is justified with the argument that if we wait until we are absolutely certain it will be too late to avoid the changes caused by humankind.[100] A discussion as to when lies are "noble" or when someone is being alarmist would be out of place here.[101] Cooperation between science and politics can be fruitful only if each area fulfills the tasks assigned to it conscientiously.

Through the Climate Convention of Rio, science has in principle received exactly what it demanded from politics at the Second World Climate Conference in Geneva in 1990. To this extent, we now have a situation which needs clarification in two points:

(1) Are the problem descriptions provided by science for the Climate Convention concrete enough to allow for regulation? This writer does not believe so. His reasons are given in the first part of the discussion above.

(2) There should be an attempt made to determine if there are not already applicable international regulations which would provide for research and protection of the climate. This question will be discussed in the following.

III. Global Climate Protection - The International Regulations

1. Overview[102]

Pollution Bulletin, Vol. 22, 1991, Pp. 169-171 (P. 170). "Buttel et al., ebenda

[100]Henderson-Sellers, A., op. cit. (Footnote 8): "The question is, 'Do most people understand that by the time we, the scientists, are all absolutely certain it will be much too late to avert most of the changes that mankind is currently effecting?[1]."

[101]Manfred Hefner wrote in a letter to the editor printed in *Die Welt* on 26 May, 1992: "Stephan Schneider, the American climatologist, wrote in *Discover Magazine* in October 1988 (!): "Scientists such as I need broad support to arouse and influence the imagination of the population. We must develop scenarios which cause fear, make drastic claims, simplify, and whenever possible avoid mentioning our own doubts. Each of us must decide what the right relationship is between being successful and being honest.'" (For the quoted works of S. H. Schneider, cf. Footnotes 6 and 7).

[102]A lot of work has been published in only a few years, whereby the legal literature is more modest in extent and strongly affected by the thesis that the climate problem is mainly a result of CO_a. A selection: Randelzhofer, Albrecht, On the Path to a World Climate Convention, *Festschrift fur Sendler* 1991, Pp. 465-481; Hohmann, Harald, Int. Environmental Law and Global Environmental Politics, *Spectrum der Mssenschaft*, 1991, Pp. 68-80; Solomon, Lewis D., & Freedberg, Bradley S., Environmental Law, Vol. 20, 1990, P. 83-110; cf. Geoffrey Palmer, New Ways to Make Int. Environmental Law, and: Stone, Christopher D., Beyond Rio: "Insuring" Against Global Warming, American Journal of Int. Law, Vol. 86, 1992, Pp. 259-283 and Pp. 445-488. For more political aspects, cf.: Skolnikoff, Eugene B., The Policy Gridlock on Global Warming, Foreign Policy, No. 79, 1990, Pp. 77-93; Hampson, Fen Osier, Climate Change: Building International Coalitions of the Like-Minded, International Journal, Vol. XLV, Winter 1989-90, Pp. 36-74.

The emergence of a global policy for the protection of the environment was neither desired nor predicted.[103] The fact that the oceans were the first object for a global environmental convention[10]" in 1954 indicates where pacemaker functions could have been centered. But the great initiative for global environmental conventions really began with the Environment Conference in Stockholm in 1972. At the Conference itself, no new international conventions were drawn up. But the "Stockholm Declaration"[105], however, provided strong impulses for international environmental law. Among the international conventions which were prepared after 1972 and which could be relevant for the climate, the following agreements are particularly noteworthy:[106]

Convention on Long-Range Transboundary Air Pollution of 13 November, 1979[107], in effect since 16 March, 1983, and amended by protocols of 1984, 1985, and 1988

United Nations Convention on the Law of the Sea, 1982[10S]; the Convention is not yet in force.[109] At the end of 1991, ratification by nine states was still lacking in order to reach the number of 60 states

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[103]Caldwell, Lynton Keith, Between Two Worlds, Science, the Environmental Movement and Policy Choice, Cambridge, 1990, P. 125; the same, International Environmental Policy, Emergence and Dimensions, Durham NC, 1984, starting p. 82.

[104]The International Convention for Averting Pollution of the Sea by Oil of 1954, which has in the meantime been replaced by the MARPOL 1973/78 and its protocols, which is undoubtedly one of the "most highly developed" and most efficient (practically and technically) international environmental conventions.

[105]Stockholm Declaration on the Human Environment of 16 June 1972, printed in: UN Doc. A/CONF.48/14. Principle No. 6 reads (excerpt): "The discharge of toxic substances or of the other substances and the release of heat, in such quantities or concentrations as to exceed the capacity of the environment to render them harmless, must be halted in order to ensure that serious or irreversible damage is not inflicted upon the ecosystems." Principle No. 7 reads: "States shall take all possible steps to prevent pollution of the seas by substances that are liable to create hazards to human health, to harm living resources and marine life, to damage amenities or to interfere with other legitimate uses of the sea."

[106]For further details, cf. Cadwell, 1984, op. cit. (Footnote 103), P. 226, where he refers to the 1976 Convention on Prohibition of Military or any Other Hostile Use of Environment Modification Techniques, which was signed by 55 states.

[107]Cf. the detailed description of Flinterman & Kwiatowska & Lammers (ed), Transboundary Air Pollution, Int. Legal Aspects of the Co-operation of States, Dordrecht 1986.

[108]After the First and Second UN Law of the Sea Conferences in 1958 and 1960, a Sea-Bed Committee became active beginning in 1967, which then took over the preparations for the Third Conference on the Law of the Sea. From 1973 to 1982, the Third UN Conference on the Law of the Sea held negotations on the 1982 UN Convention on the Law of the Sea. [109]The official text was published by the United Nations in 1983; printed with explanatory comments of the entire Convention in: Bernaerts, Arnd, Bernaerts[1] Guide to the Law of the Sea, Coulsdon, 1988.

required for the entry into force of the Convention. [110]
Vienna Convention for the Protection of the Ozone Layer of 22 March, 1985. The Convention has been in force since 22 September, 1988; it has been amended by the following protocols:
- Montreal Protocol of 16 September, 1987, on materials which lead to the destruction of the ozone layer, in effect since 1 January, 1989
- London Amendment, Amendments and Adaptations of 29 June, 1990 to the Montreal Protocol. Climate Convention of Rio 1992 (see above)

2. Comparison and Importance of the Regulatory Content

a) The Regulatory Content of the Individual Conventions

The Convention on Air Pollution of 1979 determines in Article 2 that humankind and the environment are to be protected from air pollution. Air pollution is defined (Art. 1 a) as: the direct or indirect introduction of substances or energy by persons into the air which causes a hazard.

Remarks:
If the concept of pollution is interpreted in a wide sense, then it might certainly be possible to include the greenhouse gases. The convention was actually intended to reduce the "visible" resultant phenomena of emissions, such as "acid rain".

The Law of the Sea Convention of 1982 determines that the oceans as a whole are to be protected. According to Article 192, the decisive principle reads: States have the obligation to protect and preserve the marine environment.

The Vienna Ozone Layer Convention sets down in Article 2 obligations serving the protection of human health and of the environment from harmful effects which are caused by human activity which changes or probably changes the ozone layer. In addition to a definition of the term "ozone layer," "harmful effects" are defined as the change of the living or non-living environment, including climate changes, which have considerable negative effects on human health (etc.). The modifications contained in the agreements of Montreal and London include measures which regulate the the reduction of certain gases which are particularly harmful to the ozone layers (particularly CFCs).

Remarks:
The regulatory content of this convention is basically aimed at protection of the ozone layer. The inclusion of "climate changes" is the basis of the obligation of the Party States to make provisions for research and systematic observation (Art. 3c).

The Climate Convention of 1992 aims at the reduction of CO_2 and other greenhouse gases to the extent that such gases were not included in the Montreal Protocol (Art. 4, Paragraph 2a).

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[110] Art. 308, Paragraph 2 of the Convention; the names of the 51 states are printed in Law of the Sea Bulletin, No. 19, October 1991, issued by the UN Office on the Law of the Sea, NY.

Remarks:
Just as the Air Pollution Convention of 1979 is restricted to certain substances (defined in protocols), the only concrete regulatory goal of the Climate Convention is the reduction of greenhouse gas emissions. To this extent, it would be correct and adequate if the convention were named accordingly. In terms of substantive content, the Convention for the Protection of the Climate offers little more than the Ozone Layer Convention, namely the promotion of research and international cooperation.

b) The Relevance of the Conventions for the Climate

No one can deny that each of the Conventions has some importance for the protection of the climate. In the case of the Climate Convention, this is solely a question as to whether CO_2 or other greenhouse gases actually make a significant contribution to the warming of the earth's atmosphere. At this time, there is more presumption rather than actual proof that these gases in any way directly or indirectly act on climatic events (e.g., dissolving of CO_2 in the seas). The statements about the greenhouse effect above apply equally as well to the Ozone Layer Protection Convention. In addition, there could be indirect relevance for the climate because the increase in ultraviolet radiation could damage organisms which have an effect on climatic events (e.g., sea plankton could be considered). In speaking of the Air Pollution Convention of 1979, we can assume that there is a supportive effect. But today there are still very narrow limits set on an exact evaluation.

Of these three conventions, however, the Air Pollution Convention is the closest to being well enough conceived to serve as a law for the protection of the climate. It aims to avoid air pollution in general and so to maintain the natural condition of the atmosphere. The Climate Convention of 1992 and the Ozone Layer Convention of 1985 are aimed at the cause (CO_2) and the object of protection (ozone layer), respectively.

We can also easily observe the progress of the climate debate by looking at the three conventions of 1979, 1985, and 1992. While the concept "climate" does not appear at all in the convention of 1979, there is mention in the 1985 convention, and the 1992 agreement pretends to be a climate convention, although a protocol to the Air Pollution Convention of 1979 could have achieved the same goal in comparable quality. Even though a legislature is free to define situations in need of regulation and to give names as he pleases, the manner in which this has been done in this case is an indication that co-operation between legislature and science has managed to blur the distinction between the proper tasks of the two disciplines, namely a presentation of the situation on the one hand and political action on the other. After all, enacted law is one of the most powerful manifestations of power relationships in the real world and one of the most important grounds of decisions for social behavior.[111] But this can be achieved only if the outlines of the situation which is to determine social behavior have been clearly defined beforehand. These conditions

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[111] Cf. Allot, Philip, Power Sharing in the Law of the Sea, American Journal of Int. Law, Vol. 77, 1983, Pp. 1-30 (3)

were not met during the preparations of the Climate Convention.

Although the 1982 Law of the Sea Convention does not contain any reference to the climate, the situation is well defined in this convention and this alone perhaps makes it far and away the most important legal instrument for protecting the climate and efficiently bringing the community of states together in this task.

IV. The 1982 Law of the Sea Convention - the Climate Treaty[112]

1. Introduction - No Climate Without the Ocean

A legislature cannot provide required legal regulation until the matter to be regulated has been clearly defined. The word climate alone does not satisfy this condition; climate change is not a specific idea if climate in general has not previously been defined. Apparently, not even the authors and advisors of the Climate Convention of 1992 dared to set down the traditional definition of climate, according to which climate is the average weather over a long period of time, in an international treaty. The path taken instead, that of defining and using the concept of "climate system" (Art. 1, Para, c) is little help in describing the concrete situation. In place of this concept, it was suggested above that climate be defined as the continuation of the oceans by other means or to select a definition which shows where the main points or essential causes of climatic conditions originate. These critera do not result from weather statistics. Instead, the climatic components in the global natural system are to be found in the heat storage capacity of water, its present condition (e.g., warmth, salt content, density) and the differences in distribution around the globe. This automatically puts the oceans at the focal point and is therefore an essential component for defining the situation in terms relevant for the climate.

It is not necessary to determine whether the situation as described here -protection of the oceans as protection of the climate - will need modification in the future. Whatever other factors may be considered as relevant causes of climate, they will not be decisive of themselves for the climatic events,

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[112]Under the title, "Time to Adopt a Constitution for the Oceans" (in: FAIRPLAY, Int. Shipping Weekly, 23 October, 1989, and Peace to the Oceans, Newsletter, 2-90) and in his essay: Tribunal for the Law of the Sea - Deep-Sea Mining, *Recht der Int. Wirtschaft (RIW)*, 1991, Pp. 209-218, this writer pointed out the relationship between the climate and the Law of the Sea Convention. As far as he is aware, this relationship has been mentioned elsewhere only in a Student Note of Beth H. Horness, Research on the Role of the Ocean in Global Climate Change: The Effect of Extended Jurisdiction, Ocean Development and Int. Law. Vo. 22, 1991, Pp. 71-89 (86): "Given that the 1982 Treaty is the appropriate legal regime for oceanic global warming research, the avenues to delays, disruptions, and added costs are numerous."
Cf. also the attempt to adapt the 1982 Treaty to an Atmosphere Treaty by Toufiq A. Siddiqi, Towards a Law of the Atmosphere, Using Concepts from the Law of the Sea, Honolulu 1988 (Environment and Policy Institute, Working Paper 12).

but will act primarily on the water masses, which will then in a transformation process “determine” how these components affect the condition and the dynamics of the atmosphere. Further details to be taken into account in the determining the situational description relevant for the climate can be seen in the discussion above.

2. Basic Factors Involving the 1982 Law of the Sea Treaty-[113]

The 1982 Law of the Sea Treaty is the first international agreement which has the qualities of a global constitution. With its more than twenty regulatory areas and more than four hundred individual statues, it includes all aspects relevant to the oceans which were recognized as such by the Third UN Law of the Sea Conference, which negotiated the treaty between 1973 and 1982. No one thought of the climate. Nevertheless, the following sections stand out in importance:

- Part XII, Protection and Preservation of the Marine Environment (Art. 192-237)
- Part XIII, Scientific Marine Research (Art. 238-265)
- Part XIV, Development and Transfer of Marine Technology (Art. 266-278)
- Part XV, Settlment of Disputes (Art. 279-299)

While the sections dealing with the marine environment and the settlement of disputes are categorically of obligatory nature, the parts concerning research and transfer of technology should be regarded as guidelines in the nature of a program.

In comparison with other international treaties (with the exception of the UN Charer of 1945), the 1982 Treaty enjoys particular significance which is not discernable from the text alone. Due to the extent of the regulatory spectrum and its conceptual claim as being "all-encompassing," the Party States are prevented from choosing the regulations which they like and ignoring the parts less pleasant for them ("pick and choose"). This gives the 1982 Treaty a dynamic quality which other treaties dealing with this

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[113]Introductory Literature: Bernaerts, Arnd, Bernaerts' Guide, op. cit. (Footnote 109); Churchill, R. R., & Lowe, A. V., The Law of the Sea, 1988. For a discussion of the acceptance of the treaty: Bernaerts, in: RIW, op. cit. (Footnote 112)
A good overall view of the current state of the discussion of the "value" of the 1982 Law of the Sea Treaty can be found in: Panel on the Law of Ocean Uses, U. S. Interests and the United Nations Convention on the Law of the Sea, Ocean Development and Int. Law, Vol. 21, 1990, Pp. 373-410. Thanks to the election of the Democratic Presidential candidates, Bill Clinton and Al Gore, on 3 November, 1992, it is to be expected that there will be a return to policies on the law of the sea in line with those of the Carter Administration during the 1970s. Particularly President R. Reagan is responsible for the fact that the 1982 Law of the Sea Treaty did not meet with international acceptance many years ago; he, along with Germany and England, was of the opinion that the regulation of deep-sea mining was not acceptable; these three countries are the only industrialized nations which have not signed the 1982 Law of the Sea Treaty.

problem do not have. Thus states which wish to make claims on the basis of the regulations of the Convention regarding the rights of coastal states (e.g., fishing rights, economic zone) or the right of passage for trade ships must also accept the obligations to protect the marine environment and assume responsibility for marine research, transfer of technology, and - last, but not least - accept the judgements of the maritime judiciary.

The new law of the sea is noteworthy for a fundamental change in comparison with previous international treaties. The leading principles are not the rights of the parties, but the obligations for marine environmental protection.[11]"" If it were only a question of the ratification of Part XII, then the chances for entry into force in the near future would be poor indeed. The disinclination of the states to accept the obligations of a strong international law and a loss of their cherished sovereignty as well as modification of national state thought would be too great. There is even less reason to suppose that the Rio Conference could have agreed to anything even remotely comparable. The Stockholm Environmental Conference was twenty years past in 1992.

3. The Major Regulations Relevant for the Climate in the Individual Sections

The following discussion concentrates on pointing out a number of aspects of the importance of the Law of the Sea Treaty for the climate and does not claim to be complete or a detailed analysis.

a) Regulations Concerning Marine Environmental Protection[115]

Part XII is in itself a complete constitution for global environmental protection within the Law of the Sea Treaty. It is in this respect the best conceived and, in its magnitude and coverage, the most extensive law for global environmental protection. It includes all areas which could be held accountable for marine pollution, the most detailed being the section affecting trade shipping, for which a number of exact regulations are proposed. Otherwise, the treaty limits itself to basic principles which provide a catalogue of obligations for the party states. This covers the following causes for marine pollution; from the land, by activities on the sea bed, by dumping, by ships, and from or through the atmosphere.

With a certain amount of generalization, it can be said that the obligations for the party states can be divided into five groups:

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[114]Cf. in detail: Boyle, Alan E., Marine Pollution under the Law of the Sea Convention, American Journal of Int. Law, Vol. 79/2, 1985, Pp. 347-372 (350).

[115]Cf.: Ramakrishna, K., Environmental Concerns and the New Law of the Sea, Journal of Maritime Law and Commerce, 1986, Pp. 1-19; Kindt, J. W., Marine Pollution and the Law of the Sea, 6 Volumes, 1986; Lagoni, Rainer, The Thwarting of Dangers for the Marine Environment, *Berichte der Deutschen Gesellschaft für Völkerrecht*, Vol. 32, 1992, with further references; Teclaff & Teclaff, Transfer of Pollution and the Marine Environment Conventions, Natural Resources Journal, Vol. 31, Winter 1991, Pp. 187-211.

- Guiding Principles
- Obligation to adopt and implement laws
- Special regulatory areas
- Individual regulations (particularly affecting shipping)

If these five groups are compared with other international treaties, the legal quality of the first three groups is considerably higher than the usual standard. Particularly noteworthy is the obligation of the states to adopt laws under the guiding principle of protecting and preserving the seas. The standard comparable to other treaties is found first at the level of the special and individual regulations. One of these is the definition of the "pollution of the marine environment" found in Article 1, Item 4 of the 1982 Law of the Sea Treaty. According to this definition, pollution means, among other things, "the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, . . . and reduction of amenities."[116] In comparison, the Ozone Layer Conventions formulates "harmful effects" as "changes in the living and non-living environment, including climate changes, which have considerable harmful effects on human health or on the composition, resistance, and productivity of ecological systems or materials useful for humankind, whether in their natural state or influenced by human beings." This definition is confusing and does little to clarify the situation. In the Air Pollution Treaty, "air pollution" means (excerpt): "the direct or indirect introduction of substances or energy by human beings into the atmosphere which could result in harmful effects such as a hazard to human health, damage to living resources and ecological systems or property, and a reduction of the amenities of the environment."

The concept of the law of the sea is characterized by the fact that, aside from the comparable level with other international treaties, additional guidelines and principles are set down, such as the regulation by which the party states are obligated to adopt, implement, and adapt to changing situations laws and regulations in all areas affecting the environment. The following example should make this clear.

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[116]If CO_2 is supposed as having the attribute of the term "substance" then it is imaginable that a court could determine that CO_2 is to be regarded as "pollution" in accordance with Art. 1. According to Art. 212, 222, together with Art. 192, the states would then be obligated to act (presuming that CO_2 caused a rise of the seas - certainly a reduction of amenities). Art. 222 reads thus: "States shall enforce, within the air space under their sovereignty . . . their laws and regulations adopted in accordance . . . with this Convention and shall adopt laws ... to prevent, reduce and control pollution . . . from or through the atmosphere. . . ." For more details on the topic of pollution through the atmosphere: Ash, George, W., 1982 Convention on the Law of the Sea - Its Impact on Air Law, The Air Force Law Review, Vol. 26, 1987, Pp. 35-82 (68 and following); Hailbronner, Kay, Freedom of the Air and the Convention on the Law of the Sea, American Journal of Int. Law, Vol. 77, 1983, Pp. 490-520 (510). Regarding manipulation of the weather, cf. Davis, Ray Jay, Atmospheric Water Resources Development and Int. Law, Natural Resources Journal, Vol. 31, Winter 1991, Pp. 11-44.

The Montreal Protocol of 1987 is often quoted as a sterling example of the ability of international politics to take charge of a problem even in the absence of particular obligations to do so.[117] It is relatively certain that damage to the ozone layer can also have a major effect on marine plankton.[118] Art. 212 of the Law of the Sea Treaty determines that the states shall adopt laws and regulations to prevent, reduce, and control pollution of the marine environment, which includes hindrance to marine activities, including fishing and other legitimate uses of the sea, from or through the atmosphere. If not interpreted too narrowly, the agreements reached in Montreal can be regarded as an obligation as provided by Article 212.

The overriding principles of Art. 212, particularly the guideline of the environment chapter already mention, whereby the states are obligated to protect and preserve the marine environment, means that the states cannot rely on a narrow interpretation. Since, according to the assumptions and definition given above, the climate is the continuation of the seas by other means, this guideline can also be read so that it means: The states are obligated to preserve and protect the climate.

From the viewpoint of this seaman and lawyer, it cannot be emphasized enough how important it is to establish first exact knowledge of the true situation. Without this knowledge, all measures will fall short of the goal, remain helpless, and involve the danger of even greater damage if the wrong route is taken. The situation for the protection of the climate can be clearly, definitely, and briefly stated with the words: "the ocean." Considering the importance of this principle, the lawyer cannot do more than underline this sentence several times in recognition of its significance and point out that it is comparable with Article 1 of the Basic Law of the Federal Republic of Germany, which provides that the dignity of a human being is inviolable. This sentence stands at the head of several thousand pages of laws and regulations, and every one of these is to be interpreted and implemented in the light of the guiding principle. The guiding principle for the protection of the marine environment cannot yet claim to preside over thousands of pages of laws, regulations, and standards. This could possibly have been different even today if science had long ago recognized and expressed the fact that the climate can be understood and protected only if the oceans are understood and steps taken to preserve their condition.

b) Scientific Marine Research[119]

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[117]Cf. NATURE, Vol. 357, 18 June 1992, P. 523; Nitze, William A., in: International Challenge, Vol. 11, 1991, Pp. 9-16 (13).

[118]These plankton influence a number of climatic factors, particularly the formation of clouds (cf. Savoie & Prospero, NATURE, Vol 339, 1989, Pp. 685-687; and Schwartz, Nature, Vol. 336, 1988, Pp. 441-445), but also as neutralizers of CO_2, cf. the research results of the Alfred-Wegner-Institut in: *Siiddeutsche Zeitung,* 5 November, 1992, P. 47 (The Ocean Has Many Ways of Storing Carbon Dioxide).

[119]Charnock, H., Marine Science, Organising the Study of the Oceans, Marine Policy, 1984, Pp. 120-136. Knauss, John A., The Effects of the Law of the Sea on Future Marine Scientific Research, Louisiana Law Review, Vol. 45, 1985, Pp. 1201-1219

The concept and quality of the Law of the Sea Treaty have not been reached anywhere else. Generalizing a little, this body of regulations can be described as one of the most modern and extensive.

As the 1982 Law of the Sea Treaty was being negotiated during the 1970s, the scientific community for the most part reacted negatively because of the concept. In particular, they feared they would be hindered in their work by the introduction of the so-called economic zones. The coastal states are supposed to establish economic zones reaching out as far as 200 nautical miles into the ocean, and they can claim a right of co-determination for research activities in this sea area. But as the sum of these coastal areas make up only about 16% of the total surface area of the earth, over 50% of the globe still remains under the banner of "freedom of the seas and research." Even the other points of the expressed criticism show little thought. Co-operation based on partnership with the coastal states cannot help but serve to expedite the extensive and rapid exploration of the seas.

Forcing co-operation is one of the most valuable characteristics specific to the Law of the Sea Treaty. These characteristics result from the status of the seas, which are in principle "exterritorial", and their physical structure, which make claims of possession and rule by states impossible. These factors result in a series of consequences, providing a position for the seas which differs fundamentally from that of the continents. The following aspects are particularly noteworthy:

- The seas are almost totally removed from the thought of sovereignty of states;
- The supervision and control of environmental restrictions can be conducted by anyone in front of anyone's door, (almost) without hindrance;
- Co-operation between rival national states is easier to bring about when it takes place on exterritorial" ground.

These points would be particularly favorable for extensive climate research.

c) Development and Transfer of Marine Technology[120]

This body of regulations, which was negotiated in the 1970s under the influence of the Stockholm Conference of 1972 and the first oil price shock,

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[120]Cf.: Bernaerts, Arnd, The Influence of the UN Law of the Sea Convention 1982 on the Marine Technolgy Development and Perspectives for the Federal Republic of Germany, *Verein der Freunde and Forderer des GKSS-Forschungszentrums,* Vol. 1, Geesthacht 1988; Murthy, B. S., Transfer of Technology in the New Int. Economic Order, The Indian Year Book of Int. Affairs, Vol. XIX, 1986, Pp. 435-458; Pinto, M. C. W., Transfer of Technology under the UN Convention on the Law of the Sea, Ocean Yearbook, No. 6, 1986, Pp. 241-270; Boczek, Boleslwa A., The Transfer of Marine Technology to Developing Nations in Int. Law, Honolulu 1982; Wolf, Klaus Dieter, in: Kohler-Koch, B., (ed), Technology and Int. Politics, Baden-Baden 1986, Pp. 214-243; Soons, Alfred H. A., Marine Scientific Research and the Law of the Sea, Deventer/NL (about 1983).

also enjoys particular prominence. The significance of this particular regulatory concept is especially a result of the fact that extensive marine research can be achieved only through the efforts of all states. About two-thirds of the community of states have their own coastlines. Requirements of practicality and economical use of research resources demand that each state be given the opportunity and encouraged to explore the sea area in its immediate neighborhood and to obtain, analyze, and feed back into a global observation system the required data and measurements. [121]

d) System for Settlement of Disputes[122]

Although the regulations for the system of dispute settlement are now ten years old, they remain the most modern concept for dispute settlement[1]" which the community of nations has ever developed. All of the environmental protection regulations set down in the 1982 Law of the Sea Treaty fall under the jurisdiction of this system. This means that any state can take any other state to court for violation of rights laid down by the Law of the Sea Treaty and demand that the other state fulfill the appropriate obligations. Thus one could imagine that if the Maldives or other Pacific Ocean island states succeed in proving that CO_2 is the cause of the rise of the level of the seas they could sue one or more industrialized states, forcing them to reduce emissions and pay damage compensation. But there are countless less dramatic cases imaginable which could certainly find a way into the process of international maritime law dispute settlement. This would give international environmental protection laws, protection of the oceans, and protection of the climate a new dimension and new impulses. The maritime judiciary could become one of the most important promoters for efficient climate protection.[124]

A. Problem Management - Legal Claim or Begging

As described above, scientists have been attempting since the Ozone Layer

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[121]This requirement is absolutely essential. Due to industrialization, there are today possibly already several dozen causes - including perhaps CO_2 -which affect the "normal" processes in the ocean and thereby the climate. It is quite possible that some of the causes neutralize each other, but that others have a cumulative effect. The decision as to the most reasonable and practical actions must therefore be determined by results (i.e., by the condition/trends of the oceans). Taking a real (or presumed) cause as the starting point can turn out to be a disastrous mistake. This should be considered only if there were very few possible causes and it were really possible to restore pre-industrial conditions. Note the remarks under Point A.V.

[122]Cf. Birnie, P., Dispute Settlement Procedures in the 1982 UNCLOS, in: Butler, W. E. (ed), The Law of the Sea and Int. Shipping, NY 1985, Pp. 39-68; Ripshagen, W., Dispute Settlement, in: Ripshagen, C. C., & Stephanou (ed), The New Law of the Sea, Amsterdam 1983, Pp. 281-301; Sohn, Louis B., Peaceful Settlement of Disputes in Ocean Conflicts, Law and Contemporary Problems, Vol. 46, 1983, Pp. 195-210.

[123]Cf. Lagoni, Rainer, Maritime Law Discussions in the Hamburg Representation in the Federation, Paper given on 9 April, 1990. [124]Cf. Bernaerts, RIW, op. cit. (Footnote 112), Pp. 215-216.

Protection Convention of 1985 to establish the conditions for "legal authorization" to do research on the climate by including the problems of climate change in international treaties. They believe that they have succeeded by means of co-operation with politics such has never existed before. But this does not mean in any way that the matter itself has been well served by this process.[i23] It was not necessary for either interest groups or scientists, either legislatures or states to set out on such a bold venture. International politics concluded in the form of the 1982 Law of the Sea Treaty a treaty which in its range and quality would not under current conditions be at all attainable among the members of the community of nations.[126] The difficult negotiations before the beginning of the Rio Conference were a prime example. Scientists, environmental protection groups, and other interested groups, including the states (such as those who fear they will be swallowed up) have had the option since 1982 of fighting for the generally binding implementation of the 1982 Law of the Sea Treaty and then demanding from the states and their political leaders the strict implementation of the Treaty. The effects for the protection of the climate would have been far greater than anything that has come out of the climate discussion since 1982, when, on 10 December, 119 states signed the Law of the Sea Treaty.

D. Final Remarks

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[125]Skolnikoff, Eugene B. op. cit. (Footnote 102), for example, points out that "greater understanding of the issue is essential for policy formation." As for the independence of the climate scientists, cf. Andresen, S., op. cit. (Footnote 11), P. 41. Solomon & Freedberg, op. cit. (Footnote 102), P. 91, point out that "the problem solving approach mandates that all relevant information be presented to the policymaker prior to the formulation and adoption of a solution." A good overview of the problem as a whole can be found in Andresen & Ostreng, op. cit. (Footnote 96), cf. Pp. 10, 28, 120, 150. Cf. also Nollkaemper, Andre, The precautionary Principle in International Environmental Law: What's New Under the Sun, Marine Pollution Bulletin, Vol. 22, 1991, Pp. 107-110. By no means of help is the opinion of O'Rioradan & Rayner in: Global Environmental Change, 1991, Pp. 91-108 (103) that "the fusion of science and politics is inescapable if major global change is to be averted before its discovery proves that we have acted too late"; cf. Primas, Hans, Re-Thinking in Natural Science, in GAIA, 1992, Pp. 1-15 (12): "A pact between state and science which guarantees freedom of research and allows the closing of one eye is dangerous for the continuation of our culture."

[126]The fact that they "succeeded without really knowing it or trying" only adds to the uniqueness of the situation. It is precisely not a case where politics was once again to blame, and one cannot agree with Skolnikoff, op. cit. (Footnote 102) when he says, as do many others: "The only real prospect for a different policy outcome in the near future would be if public consensus and international negotiations overcome the stubborn nature of the policy process of governments." The legislature cannot be blamed for the lack of precision in defining the problem (cf. also Skolnikoff, ebenda). The fact that the environmental law concept behind the 1982 Treaty would never have been achieved in such high quality if there had at that time been any real "understanding of the ocean" or the "understanding of the climate" shown here need not be a cause of sleeplessness for someone who wants to protect the climate.

Problems can be viewed from one point or another. When this writer attempted before the Rio Conference to interest a newspaper in an article, he received a rejection letter with the remark: "I share your skeptical evaluation of the current environmental policy debates, even though I also believe that the attempt to reduce CO_2 emissions will not cause any great damage. After all, this will sooner or later lead to a reduction in the use of energy." As acceptable as this statement is, the sense of proportions and the relationship to the problem upon which this statement (which, thankfully, was made) and the previous climate discussion have been based are just as askew.

Perhaps it was "continental thinking." Perhaps it was because the meteorologists are only interested in the atmospheric form of the phenomenon, the weather, and consider climate only as a sub-division for the statistical description of weather events. Perhaps it is one of the reasons why the small group of marine scientists, split into many different directions, believe that climate is a part of meteorology and this science already knows what it is all about. Finally, it could also be because a group of scientists has presented their knowledge of the greenhouse effect, calculated in the laboratory and at the discussion table without adequate consideration of the practical events, to the general public and politicians as having the highest degree of probability. One thing, with some few exceptions, can certainly not be said about the previous climate discussion, namely, that "oceanic thinking" has found suitable echo.

This has, as far as the seaman "understands the world," not been the case. According to his opinion presented above, the ocean is responsible for the climate to such an extent that one can speak of them being synonymous. Even if other causes not arising in the oceans could be considered as having an influence on the climatic phenomena, it would still depend on the reaction of the oceans as to how the climate would be affected.

If climate can be spoken of as the continuation of the oceans by other means, then research and protection of the climate can only be promising if we first concentrate fully on the oceans. At the moment, we do not even have an "inventory" of the oceans that is of the least use, much less the beginnings of an observational system. Instead, data fragments are stored in computers and statistics celebrate triumphs. Faith in the ability of computer simulations to make serious statements continues unbroken.[127] The oceans are much too large and complex to base everything on these simulations, and the question does not aim at normal climatic changes, but at those caused by humankind; but this means that it will be too late by the time statistics register the change.

In addition to the starting question as to what we really mean when we

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[127]But at least there are now calls for a little more differentiation. Cf. Katz, Richard W., & Brown, Barbara G., Extreme Events in Changing Climate: Variability is More Important than Averages, in: Climate Change, Vol. *21*, 1992, Pp. 289-302; "experiments using climate models need to be designed to detect changes in climate variability, and . . . policy analysis should not rely on scenarios of future climate involving only changes in means."

talk about protecting the climate, achieving such a goal requires a legal framework describing rights and obligations and setting out the means of implementation. In the three treaties concerning air pollution, the ozone layer, and the greenhouse gases of 1979, 1985, 1992, science and politics co-operated in the attempt to address concrete problems and, at the same time, to include the problem of climate change in an international treaty. These efforts have not led to recognizable progress in protecting the climate. Aside from the basic doubts as to whether a close relationship between climate change and CO_2 can even be established, alone the fact that the term climate could not be given a substantial definition and the problem specifically described means that the efforts have failed to reach the target. The "average weather" has been the basis of the climate discussion for too long. The paraphrase "climate system" now used in the Climate Convention displays a certain amount of helplessness and lack of understanding (or a lack of will to make knowledge understandable) of the basis of the phenomenon known as climate.

Some of the gaps and exaggerations in the previous climate discussion have been justified by the claim that immediate action is necessary. The reputation and importance of science has risen from one conference to the next and from press article to press article. The ocean has been given prominence only because a rise in the ocean level was helpful as a threat. The possibility of the oceans being the cause of the average increase in atmospheric temperatures was not a point.

The interested circles could have achieved much more for the protection of the climate. A strict law is the very least that is needed. For more than ten years we have had the chance to use a once-in-a-lifetime treaty in international law to protect the climate. All that was needed was for someone to determine that we cannot understand and protect the climate unless we understand and protect the oceans. We cannot exclude the possibility that with an adequate understanding and overview of the condition of the oceans we would be able to see today what the climate would be doing in the next ten, fifty, or two hundred years. What is the point of raising the level of the dikes today if tomorrow there will be a cooling-off brought about by the oceans and the ocean level falls? In order to establish reliable aids for making decisions in this and dozens of other questions affecting humankind, there is only one solution, and that is to implement soon, fully, and efficiently an instrument such as the 1982 Law of the Sea Treaty. To this extent, neither scientists nor other interested parties need to beg and plead with "high politics." All that is needed is the entry into force and global implementation of the 1982 Law of the Sea Treaty, then the demand can be made that the states fulfill their obligations arising from Article 192 and protect and preserve the oceans.

The best possible international instrument for the protection of the climate could be implemented immediately. Then we can only hope that all the fears with respect to climatic changes and climatic catastrophes were exaggerated fears. If not, and if they turn into reality, then someone, in politics or science, will have to explain why important years which could have reduced, prevented, or in some other way balanced out the extent of such a catastrophe were wasted.