PURPORTED IMPACT OF CLIMATE CHANGE ON HUMAN HEALTH

September 19, 1996

D. J. Devlin - Exxon Biomedical Sciences, Inc.

PRESENTATION OUTLINE

- Summarize Key Literature Re Purported Effects of Climate Change on Human Health
- Review/Assess "Advocates' Hypothesis": "Greenhouse Gases" Lead to Health Impacts ... Balanced Scientific Position Not Evident
- Describe Key Knowledge Gaps
- Offer Conclusions/Recommendations for Follow-up

INTRODUCTION

- **International Attention Focused on Relationships Among Greenhouse Gases, Climate Change, Ecological Stress and Human Health**
  - **National Academy of Sciences (NAS) Sponsored Conference on Potential Impacts of Global Climate Change on Health (9/95)**
  - **Intergovernmental Panel on Climate Change (IPCC) Report Reviews "State of Knowledge" . . . Raises Significant Health Concern**
  - **Medical Journals ... Relate Climate Change to Incidence of Disease**
  - **Popular Press Raising Issue of "Megastorms" ... "Global Fever" ... "Emerging Infectious Disease"**

NAS CONFERENCE

- **Conference Requested by VP Gore, to:**
  - **Encourage Experts to Address Potential Effects of Climate Change on Disease, Heat Stress, Food/Water Supplies, Air Pollution**
  - **Develop Response Strategies**
- **Organizers Assumed *a Priori*: Global Climate Change is Occurring ... Will Impact Health ... Only Degree Is Unknown**
- **Many Disciplines Involved. . . Few "Experts" . . . Many "Advocates" With a Consistent Message**

THE HYPOTHESIS

1) Greenhouse Gases Increase Due Primarily to Fossil Fuel Use

2) Accumulation Leads to Increase in the Average Global Temperature . . . 1 - 4°C in the Next 100 Years

3) Global Warming Will Affect Ocean/Air Currents and Humidity, Lead to Climatic and Geographic Changes

- Wintertime Precipitation Increase
- More Severe Weather Events . . . Increased Rainfall
- Drought Increase in Number and Severity
- Northern Snow Cover and Alpine Glaciers Decline
- Sea Level Rise (0.3 - 0.5 m by 2100)
- El Niño-Southern Oscillation (ENSO) Increase Frequency

THE HYPOTHESIS (cont'd)

4) Changes will Strain Major Ecosystems

- Decrease in Diversity of Species
- Increase in Number/Range of "Opportunistic" Species
- Relocation, Possible Reduction, of Agricultural Sites

5) Human Health will be Directly Impacted by Climatic Changes

- Suffering and Death Due to Thermal Extremes
- Physical/Psychological Injury, Death Due to Weather-Related Disasters

THE HYPOTHESIS (cont'd)

6) **Human Health will be <u>Indirectly</u> Impacted by Physical and Ecological Changes**

- **Range/Activity of Disease Vectors and Infective Agents Will Increase . . . Alter Range, Intensity and Seasonality of Vector-Borne Diseases**
- **Increase in Water-Borne Diseases Through Disturbances in Fresh Water Ecosystems**
- **Population Displacement Due to Rising Sea Level, Regional Declines in Food Production, Weather Disasters . . . Lead to Increase in Malnutrition, Injuries, Infections, Civil Strife**

THE HYPOTHESIS (cont'd)

- Increase in Pollen and Spores . . . Lead to Increases in Asthma, Allergies and Other Respiratory Diseases

- Increase in Particulates and Ozone ... Increased Hospitalizations And Deaths From Cardio-Pulmonary Diseases

7) Combination of Infections, Malnutrition, and Social Stress, Especially in Displaced Groups, May Amplify Health Impacts

BASIS OF DIRECT EFFECTS

- **Sudden Extreme Increases in Ambient Temps Result in "Excess" Deaths**
  - Elderly, Sick, Very Young Have Limited Physiological Capacity to Adapt
  - Urban Poor Lack Escape from Exposure ... "Urban Heat Island Effect"
  - "J-Shaped" Relationship Between Daily Death Rates and Outdoor Temp.
- **"Threshold Temperature" Proposed: Statistically Derived Temp. Beyond Which Mortality Rises Significantly**
  - Varies Regionally: > 86° F, Deaths in NYC ... No Effect in Jacksonville, FL
- **Other Factors Exacerbate Effect of Heat: High Humidity, Low Wind, Solar Radiation ... "Oppressive Umbrella of Air"**
- **Wintertime Deaths from Influenza and Hypothermia Predicted to <u>Decrease</u>**

BASIS OF INDIRECT VECTOR-BORNE EFFECTS

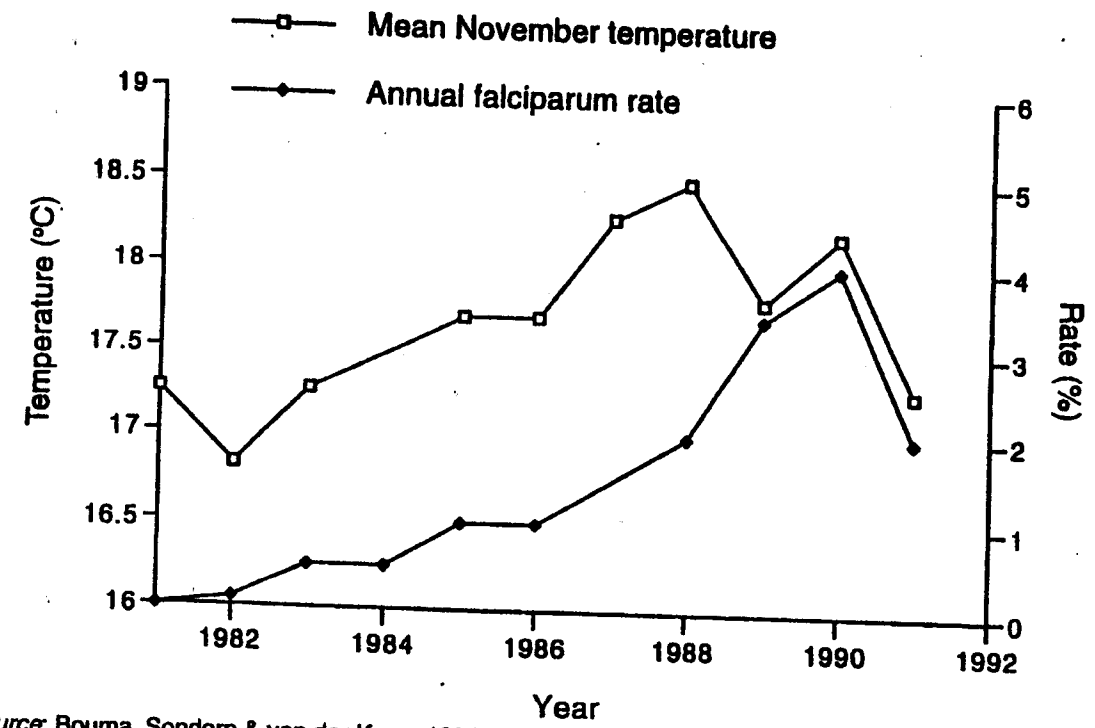
- **Evidence Indicates Vector Organisms and Infective Agents Sensitive to Climatic Factors ... Natural Regulatory Forces**
  - **Temperature:**
    - **Increase Accelerates Metabolic Rate ... Increased Biting Rate For Blood-Feeders, Increased Egg Production**
    - **Longevity Of Female Mosquito Decreases Above 77° F (25°C)**
    - **Arthropods Have Optimal Range . . . Changes in Minimum Temp. Could Be Important**

BASIS OF INDIRECT VECTOR-BORNE EFFECTS (cont'd)

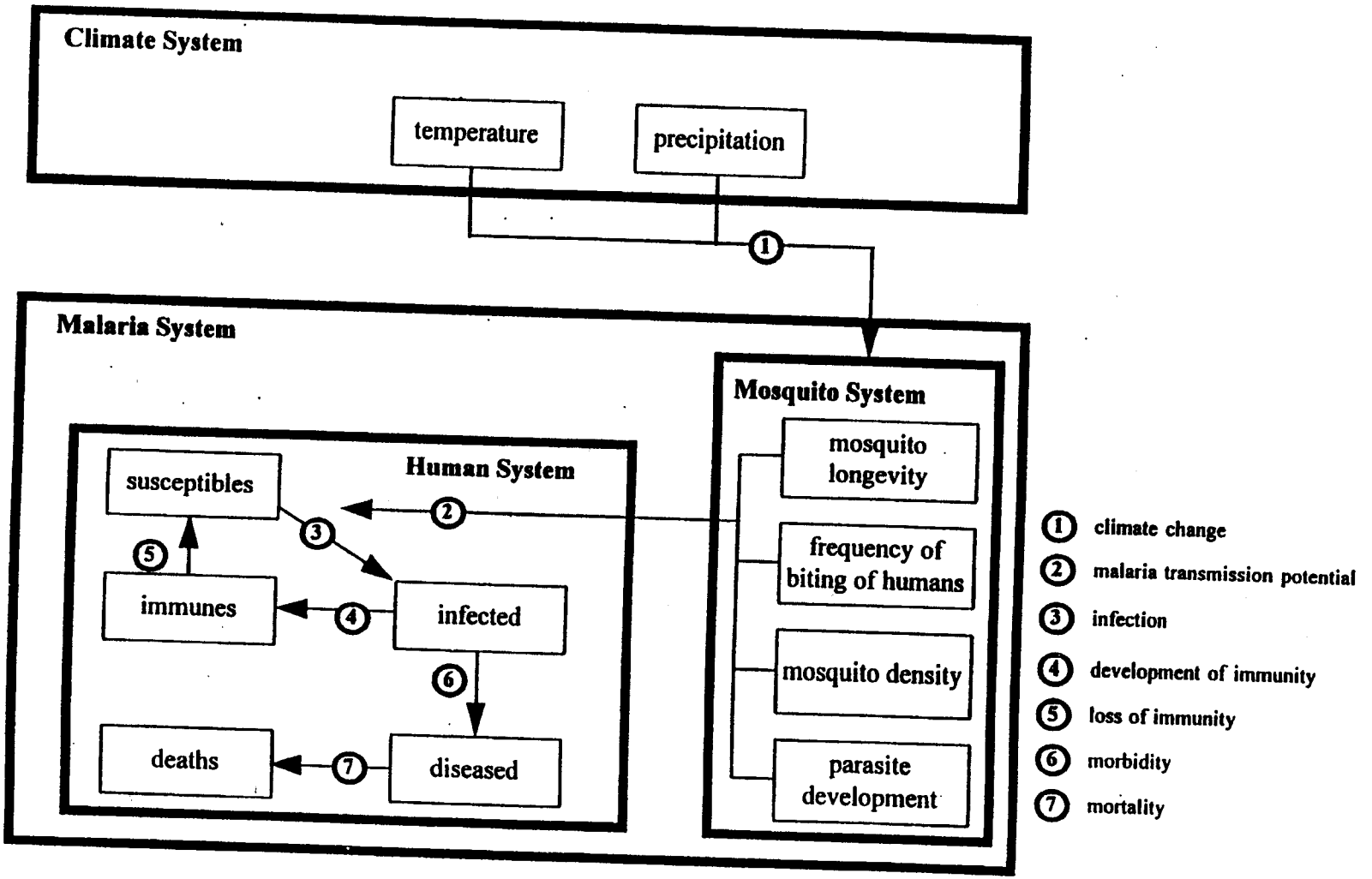
- Precipitation: Water Critical for Some Breeding Sites: Mosquitoes and Blackflies Have Aquatic Larvae/Pupae Stages
- Humidity: High Relative Humidity Favors Most Metabolic Processes of Vector Organisms, but Infections of Vectors by Fungi Increase
- Wind: Contributes to Passive Dispersal of Flying Insects

- **Examples Cited Include:**
  - Epidemics of Malaria Following Atypically Hot/Rainy Periods
  - Emergence of Rodent-Borne Hantavirus in U.S. (1993)
  - Occurrence of Dengue Fever Doubles with 3 - 4°C Rise

Fig. 4.3. Variations in November temperature and annual falciparum malaria rate in north-east Pakistan between 1981 and 1991



Source: Bouma, Sondorp & van der Kaay, 1994a.



Systems diagram of a model designed to assess the impact of climate change on the potential transmission of malaria (adapted from Martens*et al.*, 1994).

BASIS OF INDIRECT WATER-BORNE EFFECTS

- **Cholera a Major Concern ... Affected by Precipitation Extremes**
- **Marine Plankton as Reservoir for *V. cholerae* ... Usually in Dormant State**
  - **Higher Sea Temperature ... Increased Plankton Population and Reemergence of *V. cholerae***
  - **Association Between El Niño and Cholera Outbreaks Actively Studied**
- **Diarrheal Diseases Peak During Hot/Wet Seasons**

KEY KNOWLEDGE GAPS

General

- Predictive Models Largely Unvalidated

Direct Effects

- Significance of "Mortality Displacement" During Excessive Heat
- Moderating Effect of Acclimation, Infra-Structural Changes

Indirect Effects

- Better Understanding of Complex Relationship Among Vector, Parasite, Human, and Climate Changes
- Extent to Which Human Intervention Can Mitigate Potential Impacts of Climate Change on Health

CONCLUSIONS

- Balanced View Not Evident in Peer-Reviewed Journals, Public Media
- General Consensus That Climate-Induced Changes in Public Health Extremely Difficult to Quantify
  - Multiple Factors Lead to Wide "Natural" Fluctuations
  - Predictive Computer Models Difficult to Validate, Do Not Reflect Adaptive Response
- "Hypothesis" Advocates State Risks are High . . . "Precautionary Principle" Dictates that Lack of Scientific Certainty Can't Justify Postponing Preventive Action

CONCLUSIONS (cont'd)

- **Minority View: Evidence Must be Weighed . . . Plausible Mechanisms Defined . . .Relative Significance Assessed**
  - **Climate Change is Likely a Marginal Factor. . . More Critical Issues Exist: Malnutrition, Personal Hygiene, Drug Use, Food Prep, Urbanization, Population Growth, Trade and Travel, Evolution of Microbes, Inadequate Public Health**
- **Impact of Climate Change on Human Health will Remain Speculative . . . Provides a Potentially Emotional Issue**

POTENTIAL NEXT STEPS

- Monitor and Critique Ongoing Developments
- Identify and Critique Relevant Predictive Models
- Identify Scientific Leaders with Diverse Views . . . Encourage Active Participation in Debate
- Promote Concept of Relative Risk . . . Significance of Climate Impacts Vs. Other Disease Factors