

Marine Pharmaceutical Discovery

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Pharmaceuticals - Greatly Improving Life



- Enormous societal benefits
- Many diseases cured
- Quality of life improved
- Economic advantage to US - major producer
- Society becomes dependent on drugs

An “Unrecognized” Medical Emergency

- **On one hand, biomedical research has never been stronger.**
 - **new biotech startups**
 - **era of human genomics**
- **On the other hand, we are in a major medical emergency.**
 - **“modern, age related diseases”**
 - **increasing incidence of drug resistance!**
 - **epidemics of TB, pneumonia, anthrax, etc.**
 - **emerging diseases: Herpes**
 - **frightening new viruses: “Ebola”**

Nature - The Traditional Source for Drugs



- Natural drugs used for over 3000 years.
- Traditional medicines common today in many parts of the world.
- Many natural drugs have been used for cancer and other difficult diseases.

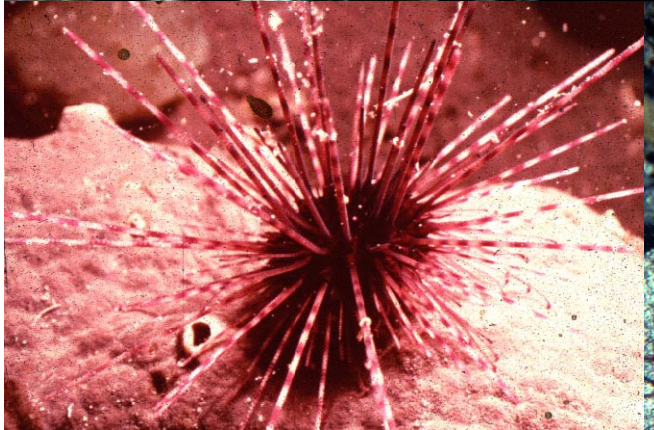
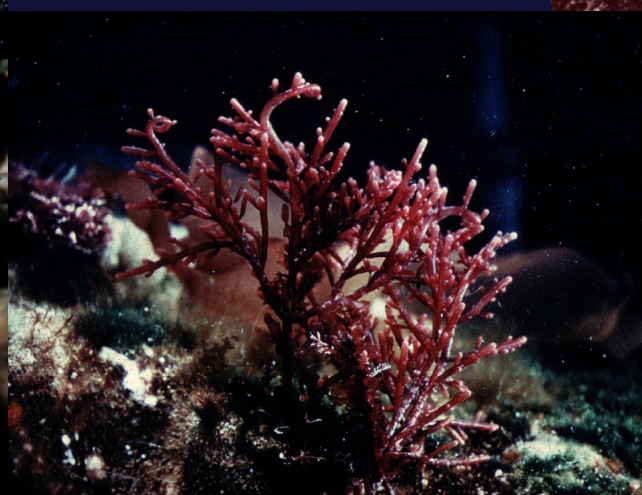
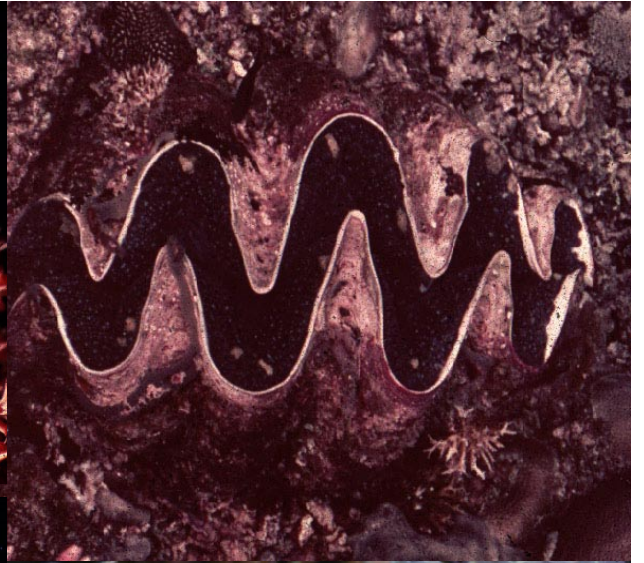
The Pharmaceutical Industry is Based on Natural, Terrestrially-Derived Drugs !

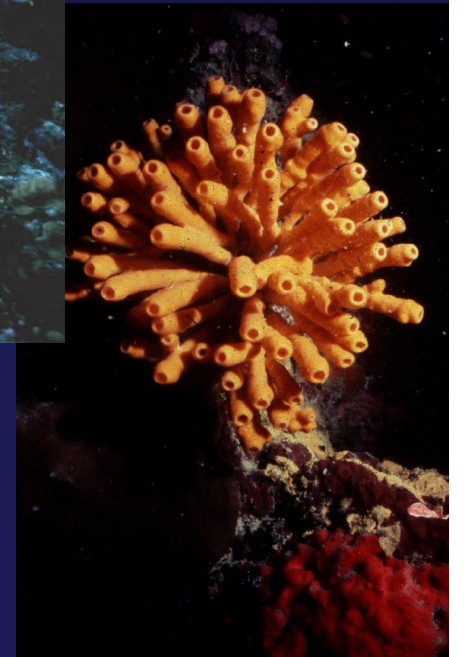
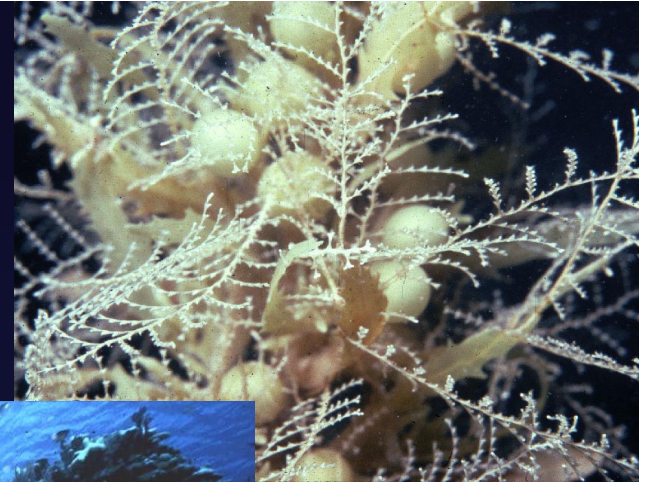
The Global Ocean - Our Most Diverse Resource



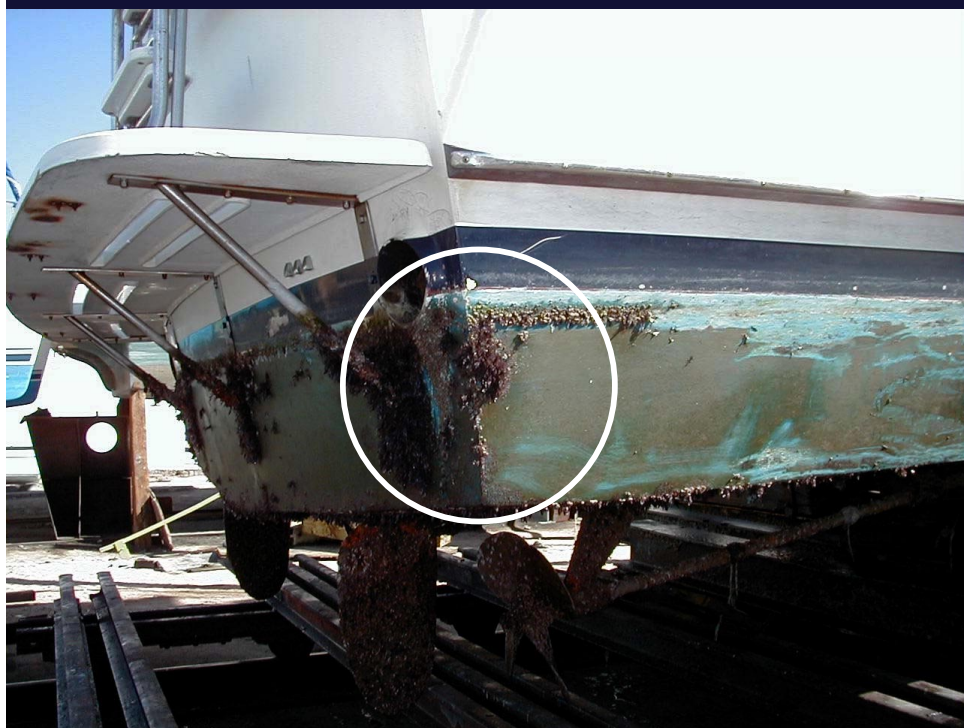
- The oceans are our most biodiverse environment with 34 of the 36 known phyla represented.
- By comparison, the land has only 17 of the known Phyla!

Genetic diversity translates to chemical diversity = Promising new drugs.

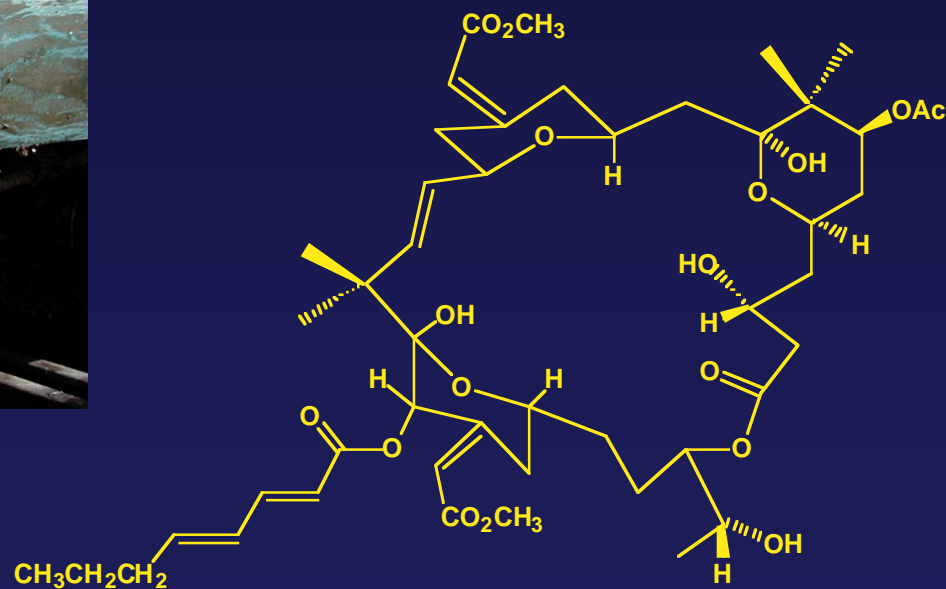




Fouling Animal *Bugula neritina*



This animal produces a potent immunostimulant and anticancer agent.

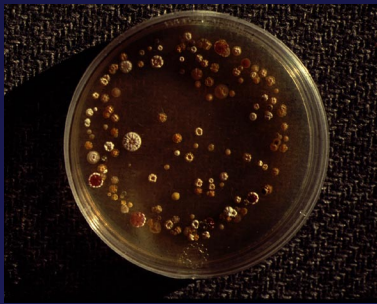


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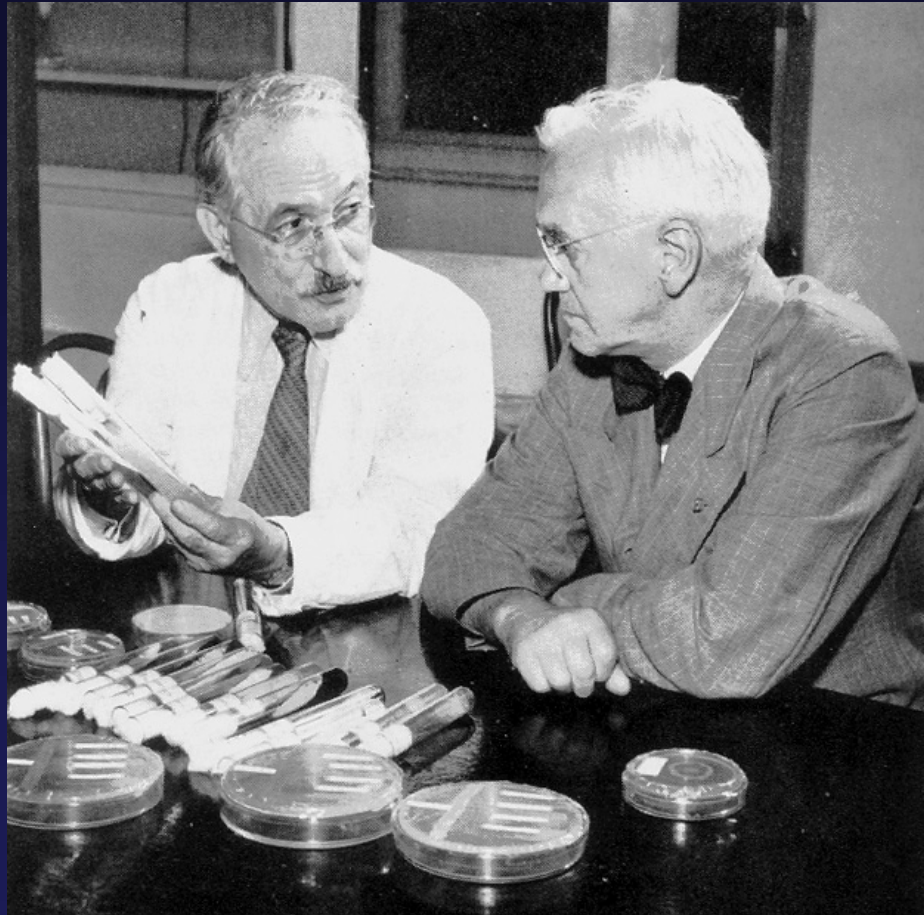
Medical History - The Discovery of the Antibiotics

**Selman Waxman
1930s:**

**Discoverer of the
actinomycetes as an
antibiotic resource**



**Actinomycete
bacteria**



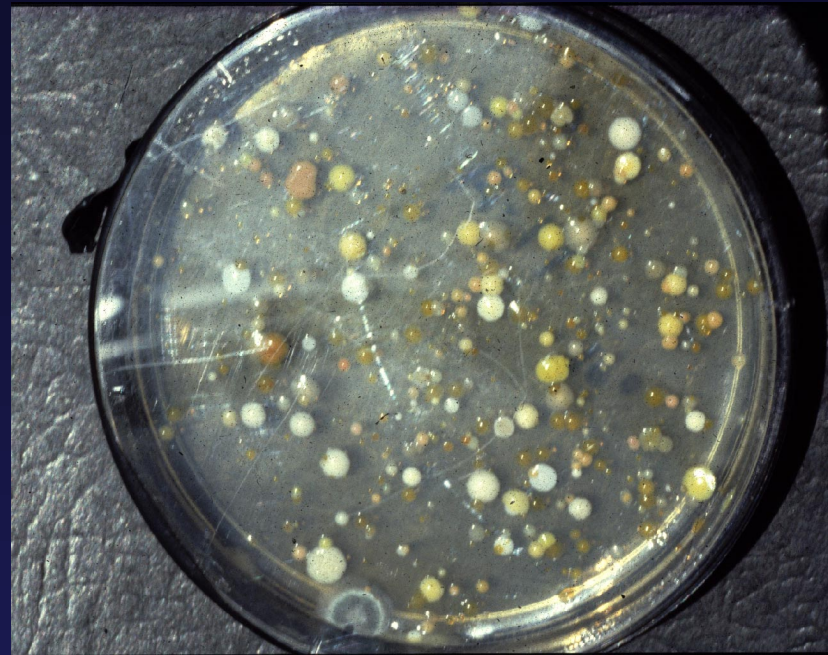
**Alexander Fleming
1929:**

**Discoverer of penicillin
From the fungus *P.
notatum*.**



Fungi

The Ocean as a Source of Diverse Microorganisms



Even ordinary seawater contains 10^6 microbes per milliliter!

Sediments, world-wide, contain 10^9 microbes per cc!

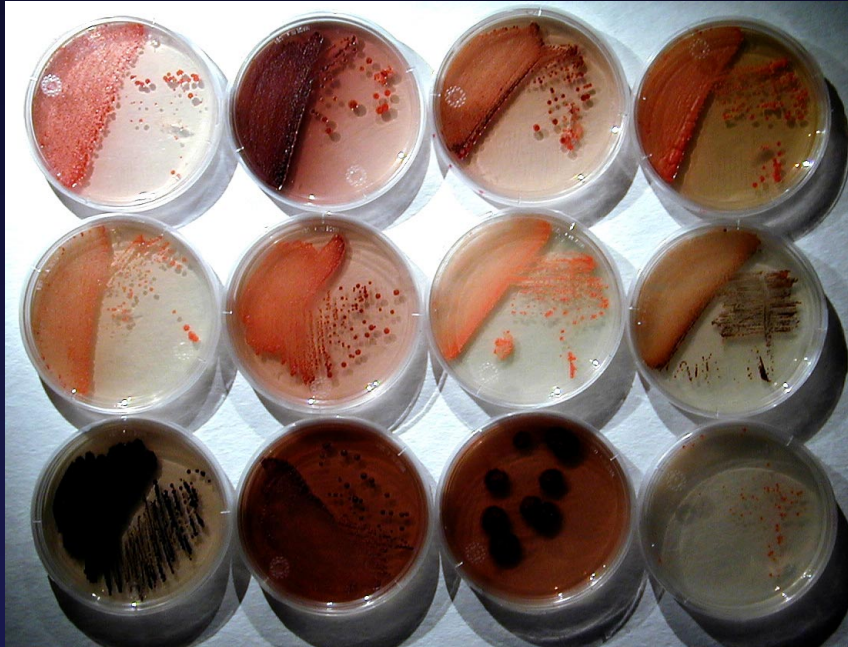
Deep Sea Sediments



“Green” mud samples
From deep ocean sites



Entirely New Microbial Groups Discovered!



A new genus, the “*Salinospora*”

Another new genus, the “*Marinomyces*”



Marine Pharmaceutical Discovery

- We are just now recognizing the role of the oceans in the future of human treatment.
- Major opportunities exist for fundamental scientific discovery and commercial development.
- The US needs to emerge as the world leader in this activity.
- Multidisciplinary programs are needed which facilitate this activity.

NIEHS/NSF Collaborative Program
“The Oceans and Human Health”

SCRIPPS INSTITUTION OF OCEANOGRAPHY

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April 24, 2002

Admiral James D. Watkins
Chairman
U. S. Commission on Ocean Policy
1120 20th Street NW, Suite 200N
Washington, D.C. 20036

Re: Marine Biomedical Discovery

Dear Admiral Watkins,

This letter is written subsequent to my testimony at the Commission meeting in San Pedro on 18-19 April, 2002. Although I had ample time to make a clear statement regarding the future benefits of marine biomedical research, the commission was seriously side-tracked by comments made by another scientist requesting support for access to MPAs, "marine protected areas," for research purposes. Rather than focussing on the benefits of supporting marine biomedicine, the commission members were side-tracked into a rather lengthy discussion on MPAs. Unfortunately, this diversion seriously reduced the Commission's Q and A on the relevant issues associated with this topic. Thus, please accept this additional communication as an addendum to the testimony presented in San Pedro. Hopefully the entire Commission will have the opportunity to receive this.

Marine biomedicine is one of the most recent focal points in assessing the role of the oceans in human health. There is simply no question that the vast diversity of plants and animals in the sea will contribute toward the amelioration of human suffering. If programs are designed to address biomedical questions, the marine environment is sure to lead to new drugs, and new understanding to facilitate treatment of human ailments such as cancer, infectious diseases, neuro-degenerative diseases, and many more.

The oceans are the last great frontier for biomedical research. We have learned much from the life on land, but it is now time to access the wealth of information in the sea. The issue is not simply the discovery of new drugs, but harvesting the metabolic, genetic and physiological information inherent in the evolution of lower species of life. The unique adaptations and diversities of invertebrate life alone promise to create opportunities to understand the evolutionary development of signals which regulate cell cycles and which control resistance against cancers, pathogenic microbial infection, and the process of aging itself. Although we have recognized this potential, there are structural restrictions inherent in our Federal Granting Agencies that make progress difficult. The limits built into our major foundations

virtually restrict research that crosses borders. For example, the National Science Foundation specifically restricts biomedical research, creating great difficulties in establishing programs which combine “pure,” environmental and biomedical research. Likewise, the National Institutes of Health focuses its efforts on supporting “pure” medical research, thus precluding ancillary studies of systematics, ecology and species distributions, which are the foundations of an effective study of marine biomedical resources. Indeed, the very structure of our science support system is counterproductive to establishing the type of multidisciplinary programs required to advance this discipline.

There are exceptions to this critique, but here too there have been major difficulties. The US Department of Commerce’s “Sea Grant Program” has been a major contributor to marine biomedicine over the past 20 years. Their charter addresses this area and they have been very strong supporters of this field; perhaps they have been the major driving force in establishing this field. This program is small, however, it is a major focal point of political critique, and it seems misplaced within the governmental structure.

Clearly, new approaches need to be established to allow cross-disciplinary research to be developed. In the marine biomedicine field, such a program is in development right now. I refer to the joint NIEHS / NSF Initiative on the “Oceans and Human Health,” a program is wisely formulated to facilitate the use of funds to support diverse scientific activities. This innovative program is worthy of support from the U.S. Commission on Ocean Policy, and I certainly hope that the Commission will do so.

In summary, everything is in place for the US to enter into a new frontier of marine biomedical research. This new frontier will not only provide us a great deal of new insight into how the oceans function, but it will generate a competitive commercial edge in the discovery of new medicines for the next decades and century. Aggressive activities now will give the U. S. a major advantage over others, particularly the Japanese, in developing and profiting from this major new technology.

Lastly, I am enclosing a copy of my presentation as a pdf file to be formally entered into the testimony for the Commission.

Sincerely,

A handwritten signature in black ink that reads "William Fenical". The signature is written in a cursive, flowing style.

William Fenical
Professor of Oceanography
Director

cc: Members of the Commission