

ROUGH DRAFT

- 1 -

Revelle

I want to tell you how gratified we are that such distinguished company has been willing to come here to discuss what is after all a very small piece of science and a very small institution. As you will no doubt observe during the course of the next three days I think and most of us here at La Jolla think it's a very important realm of science and actually in some ways Oceanography forms a central focus for a great many scientific disciplines. But nevertheless quantitatively oceanography is a minute field and this is by the standards of modern ~~academic~~ academic and research institutions ^{minute} is a ~~small~~ institution. The purpose of this conference is to try to ~~get~~ assemble if we can and to solicit the best thinking that we know of to help us with the growing pains of the Scripps Institution. In some ways during the past few years the Institution may have gotten too big for its britches, and we want to see whether this is true, whether we want to get any bigger, what direction we should go and how we can accomplish such desirable ends as we may reach here by ~~full~~ agreement. We don't intend to ask you to pass on any resolutions. If anybody feels that there ought to be a resolution, certainly we ~~will~~ not object. But we will be quite satisfied if all of you state your ideas as freely and as frankly and in as hard-boiled a manner as you possibly can. We would feel that we had failed at the purpose of this conference if people were polite. We want you all to be frank and state what you really believe. We guarantee that our skins will be thick enough to take any unkind words. We plan tonight to talk about the educational program of the Scripps Institution and about the history and growth of this Institution, and to discuss after the presentation of two semi-formal papers the educational problems of this campus of the U. of C. Tomorrow morning there will be three papers by three of our senior faculty members on the research program at Scripps Institution. We hope to devote some time of the balance of the morning to general statements of the problems which we believe we're facing, and perhaps to begin on a discussion of some of these problems, other than the educational problem. We hope to continue this discussion of what we believe to be our ^{tomorrow} problems/night. And on Tuesday to discuss what is our issue of the

Possible future of this campus of the U of C within the University and the role ~~that~~ of oceanography in the development of the U.S. and in advancing the peoples of the world. I will act as chairman tonight and try if I can to guide and restrain the discussion as far as possible to educational teaching problems. We are going to call on various of our distinguished visitors to act as chairman on successive meetings of the conference. I hope they will be at least as hard-boiled as I will try to be and keep the discussion ~~restricted~~ focused on a few central issues at a time. We want to discuss all of the issues but it seems to me it may be easier if we try to talk about one thing at a time. I'd like to call first upon Dr. Claude E. ZoBell, ~~who is a professor of marine microbiology on the faculty of the department of oceanography of the U of C., head of the division of marine microbiology at Scripps Institution.~~ who is a professor of marine microbiology on the faculty of the department of oceanography of the U of C., head of the division of marine microbiology at Scripps Institution. He will discuss the history and growth of the Scripps Institution.

Dr. ZoBell

Professor Revelle, distinguished guests, colleagues and friends. This is indeed a great day in the history of ^{the} Scripps Institution of Oceanography. During the short time that I ~~can~~ occupying tonight^{is} my assignment to attempt to point out briefly some of the events leading up to this day when we have met to consider some of the problems of the future of the Institution. If we look back ~~to we will~~ ^{only see} where we have been, it is important therefore to look forward so we can see where we are going and it is my understanding that that is the purpose of this three-day conference. What is now known as the Scripps Institution of Oceanography had its beginning nearly 60 years ago in the pioneer efforts of Professor William E. Ritter of the Department of Zoology, University of California at Berkeley who sought an outlet to the sea, who hoped to have an opportunity to study the marine environment and have an environment ^{for} ~~for~~ taking students for studying the ocean and its inhabitants. ~~the text~~ After a decade of a somewhat nomadic existence, during which time Professor Ritter and his handful of students ~~set up~~ summer quarters on various parts of the coast of California, Pacific Grove, San Pedro, Long Beach and elsewhere, they were finally offered a home by the City of San Diego at Coronado when in 1903 the organization was incorporated as the Marine Biological Association of San Diego supported primarily by the Chamber of Commerce and by certain public spirited citizens who contributed financially and otherwise to the support of the work. It was about this time ~~x~~ that E. W. Scripps and Ellen B. Scripps became interested in this ^{pioneer} work of Dr. Ritter and it was about this time that they started to contribute substantially to the financial support of the work and otherwise to encourage the efforts of Dr. Ritter and Dr. Kofoid who by this time had joined him in these efforts. Up until this time, however, the work had been conducted only ^{on a} ~~by~~ summer-time basis and with a temporary staff only such as could be borrowed from the Department of Zoology, ^{at the} University of California during the few summer weeks. After spending two years in temporary

laboratory quarters at Coronado, the first real ^{home that the organization} had was constructed very near here at the cost of ^{some} \$1,000.00 which in those days 1905 was adequate to build a rather substantial laboratory sufficient to house two resident biologists, to take care of a dozen students during the summer and others who were working at the Institution at that time when the building was constructed here on the present site of the part in La Jolla. The work is ~~was~~ conducted ^{from close} quarters as a marine Biological Association until 1910 where the first building on the present campus, The George W. Scripps Memorial Laboratory was dedicated and the work was moved out there in 1910 to the present 177 acre campus which we still have in its entirety. Two years later, 1912, the organization returned to the ^{fold} of the University of California as was the intent of the _____ and the organization was ~~to~~ incorporated ~~it~~ as the Scripps Institution for Biological Research of the University of California. At that time there was a total of six people connected with the organization. ^{who were} Four years later there was dedicated the present library museum building which was also used for administrative offices and ^{also made} ~~it was also made~~ ^{was} available ^{steel} the present concrete reinforced 1000 foot pier which serves as a very important part of the work of the institution, has served us well for making many types of observations, ⁺ many types of collections since that time. The next important development in the growth of the Institution ^{occurred} appeared in 1925 when due to the change in the emphasis of the work, ^{due to} the emphasis that was placed more and more upon oceanic phenomena and the oceanic environment in general, the name of the organization was changed to the Scripps Institution of Oceanography of the University of California which name has persisted until the present time. Although it is my personal hope that before the termination of this conference someone will make the recommendation that it be changed once again, possibly this time to the Institute of Oceanology, as being more appropriate. And then when I and certain others of my college are called upon to speak a field _____ and we are introduced as coming from the Scripps

Zobell

Institution, we will not have to explain whether we are staff members or inmates. ^{Ritter Hall} We recall, the third ^{permanent} building was made available in 1931 and twenty years later the Thomas ^{Wayland} Vaughan Aquarium Museum building will ^{be} ~~become~~ made available and dedicated to its intended purpose tomorrow at the program. During this sixty year period other aspects of the Institution have developed a ^{pace}. The library has increased from a few ragged volumes borrowed from the zoology department to a fine library consisting of approximately 50,000 bound volumes and more than twice this number of charts, ~~and~~ maps, reprints and other collected works. So we do have one of the finest and most specialized oceanographic or oceanological libraries in the world at the present time. Although it is still quite inadequate for its intended purpose, nevertheless it is probably one of the biggest and one of the best. Only recently have we obtained the services of a trained librarian to take care of this fine collection of literature who is now assisted by two assistants. Prior to this time it had for the most part only clerks, stenographers, and other people taking charge of this ^{important} aspect of the work at the Institution. Another important development that has made possible the growth of the Institution and has made possible ^{contributions} ~~to contribute~~ to the science of the sea has been the matter of the ships, ^{our floating} Laboratories or our means of collecting data of various kinds from the oceans of the world. During the early period of the Institution we depended primarily upon ~~down~~ rowboats and other small craft\$ for offshore collections of various kinds. During the period from 1901 to 1902 we had the ship, the ^{Eric} ~~Kelsey~~, a small gasoline powered boat which made it possible to collect samples from considerable distance off shore. During the period from 1904 to 1906, we had a 19 ton schooner The *Soma*, which made many important collections immediately off our shores here. And then for ten years, from 1907 to 1917, we had the Alexander Agasy, a 40 ton ship of 76 feet, which has made history in many ways for one [?] data and various types of equipment and various types of samples which were collected by the Alexander Agasy. From the beginning of the first world war until 1925 the Institution

Zobell

had no ship but depended primarily upon obtaining crafts of various kinds from the fishing industry, from the Navy, the Coast Guard, ^{from} *at times* we made use of the personal Scripps yacht and other vessels of this type were ^{used} ~~made~~ for Oceanographic collections. In 1925 we obtained the ship, the Scripps, which is not the E.W. SCRIPPS that we have at the present time, because the Scripps, a 64 foot ship of 22 tons ^{burned} ~~built~~ in 1936 ^{and it} ~~that~~ served us well collecting data at Stations 1,2, and 3 and collecting biological data from various stations for this ten year period. In 1936 we obtained the ^{greater} type schooner the E.W. SCRIPPS, which many of you saw today and visited, 104 foot vessel of 109 tons. We still have it and it is supplemented by three other ships which ^{materially} has made it possible for us to expand our work/in many ways. The present fleet consists of, in addition to the E.W. SCRIPPS, the Paolina-T, an 80 foot vessel of 110 tons, the ^{craft} ~~Kraft~~, ¹³⁶ ~~136~~ vessel of 320 tons, and the Horizon, a 143 foot vessel of 600 tons, and as Roger has already indicated we are negotiating for ^{field} ~~yet a sixth~~ vessel in order to make it possible to expand the work more and more toward the sea, which many of us believe is the direction that the future ^{growth} of the Institution should take. A word about our relations with the University of California. *As I have* indicated it started as a part of the Zoology Department and later became a ^{civic} organization so that there were ^{several} ~~7~~ years ^{administrative} when there was no direct/contact, although there was a loose academic arrangement with the University of California until 1912 when it became officially a part of the University of California. And since that time the University has contributed substantially to the financial support of the work of the institution. Since that time there has been arrangements whereby students, graduate students, could come here and do advanced work, leading to the Masters or Ph.D degrees, or many ~~arrangements~~ ^{the} cases arrangements whereby special students from the departments of chemistry, biology, ^{after} physics or other departments could come here on a part-time basis to specialize in some of the marine sciences. At first our academic and administrative

Zobell

relationships were exclusively with the part of the University at Berkeley, but ^{as} U.C.L.A. grew and developed into a fine part of the University our affiliations have gradually *been* transferred to this branch of the University until at the present time academically most of our relations are with the branch of the University at Los Angeles. Administratively this is largely true although we still have a close tie-in with certain administrative aspects of the work ~~of~~ at Berkeley for reasons ^{that} which should be quite obvious. Dr. *Rockett* ^{Im} will probably have more to say about ^{the relationship of} our academic program with that part of the University of California. Our present staff, though ^{large it may seem} ~~to a large degree~~, from the point of view of those who handle the ~~payroll~~ payroll, nevertheless seems to be woefully inadequate in face of the tremendous task that confronts us, namely the study of the sea ^{of} in all its aspects. Actually we have only 14 academic staff members, although we may have between 230 and 240 employees and we may have between 60 and 70 graduate students, we have only 14 academic staff members, ^{whom} ~~Three of these~~ are ^{at} in the marine physical laboratory. So it seems that we are understaffed from the point of view of academic staff. We have with us only four 20 year men. Dr. *McEuen*, who is with us tonight joined the staff as a physicist in 1908 and has been more or less continuously with the ^{organization} staff since that time. Professor Fox came in 1931 as did the speaker and Dr. Revelle came to us as a graduate student in 1931 where he took his degree and has been an instructor at the Institution since 1936. In addition to these four 20 year men, we have two ten year men and most of the other staff members have joined the ^{an} institution more or less during the less decade. It is something to be considered in ~~the~~ the future that four of our senior staff members can be expected to retire within the next decade or so, a matter of considerable importance it seems to me in planning for the future of this organization. In view of the tremendous problem that confronts an Institute of Oceanography it seems to me that we are dreadfully understaffed in all respects, particularly when you stop to consider the vast expanse of the problem that confronts us. I made a few calculations and came up with a figure that we have something like two-hundredths of 1 % of the world's scientists and teachers

Zobell

ROUGH DRAFT

-7-

beyond the high school level who are devoting their time to the study of the other 2/3 of the earth, meaning that the ocean covers about 70% of the surface of the earth. *Oceans influence the* well-being of man in ever so many ways. It strikes me as being somewhat ~~in~~ *anomalous* ~~that~~ *have* until recently we had known far more about the topography of the moon than we had known ~~about~~ regarding the topography of the bottom of the ocean. It strikes me as being somewhat *anomalous* that we ~~knew~~ *far* more about the movement of the heavenly bodies than we know about the movements of the oceans of the world. These are problems which require much more attention but before they can receive attention, it is necessary to have staff to work on the problems or even to formulate the problems. Before we can have a staff it is necessary to teach students, specialists, who can become qualified to work on the problems, before we can even get started and this is one of the important functions of this organization and other similar organizations which are devoted to the study of the ocean and its relation to man. It is necessary ~~to~~ *that we* devote much more attention, it seems to me, to a study of ~~several~~ *certain* theoretical and fundamental aspects of the ~~study~~ *science* of the sea. If I could have taken time to point out that ~~much of our~~ *great* increase in forwarding this institution has occurred during the last ten years due to contract research work of various kinds, we could emphasize that many of the problems on which we have been working are problems which are supposed to have certain practical applications. While it is true that we ~~have~~ *are doing* certain theoretical and fundamental work it seems to me we should be doing far more theoretical and fundamental work than we are doing at the present time rather than putting as much emphasis as we are advised to do in the interest of the financial support for the work, emphasis *form* applied on utilitarian aspects of oceanographic research. Personally in my own little sphere of marine microbiology I often *feel as futile as a* flea climbing the leg of an elephant, with ~~reductio~~ *intent*. When I think of the tremendous import of microorganisms in influencing the economy of the sea as compared with the *trivial* efforts

Zobell

of one man together with a few students can make in such a tremendously large undertaking. And I am sure my colleagues who are undertaking their specialities must have a similar feeling of futility at times in the face of the tremendous greatness of the problem that confronts us. ^{As has been} indicated already the first director of this institution was Dr. William E. ^{Ritter} ~~Rickers~~, who was responsible primarily for the exploratory ~~reconnaissance~~ ^{reconnaissance} which delineated many of the problems of oceanographic research. He was responsible for the ~~first~~ organization of the first seaside laboratory of the University and it was his attitude primarily that this laboratory should provide for the subsidization of capable men and individuals so that they could make the types of investigations that interested them most. He was succeeded in 1924 by Thomas ^{Wayland} ~~Whelan~~ Vaughn who came here emphasizing primarily the international aspects of oceanographic research. Also he emphasized the inter-relationships of the various ^{which} ~~disiplines~~ ^{which} that go to make up oceanography. And as a result of his efforts Dr. Vaughn had instigated during his administration ^{in the} ~~in~~ the field of biochemistry and ^{comparative} ~~in~~ physiology, geology, chemistry, micro-biology, he provided for increased emphasis upon marine invertebrates. Dr. Vaughn was succeeded in 1936 by Harold ^{Sundrop} ~~Sundrop~~. At this time the Institution had a total of 38 employees, including all categories, from clerks, janitors, up to the director. The emphasis of Dr. ^{Sundrop} ~~Sundrop~~ was upon physical oceanography. Also he put much more emphasis than had been given in the past upon the teaching program as well as certain aspects of the research program. During his administration there was much more work at sea. It was also during his administration that we embarked upon our present program of contract research., during which time we had contracts with such organizations as the ^{Kelco} ~~Kelco~~ Company, certain power and light companies, the American Petroleum Institute, the Bureau of Ships, and more recently other governmental agencies. During the present administration, that of ^{Carl} ~~Paul~~ Eckart and Professor Revelle, ~~it~~ the emphasis it seems to me has been primarily upon attempts to create a climate for research and advanced study. An atmosphere in which research men can have fun doing the things they want to do provided ~~it~~ has to do with

Go Bell

accumulating information regarding the oceans of the world. ~~Since~~ the present administration has put much emphasis upon teaching on a higher level. It has been said many times at some of our staff meetings that the Pacific is our "oyster", if I may use ^a the quotation, to indicate that the work of our institution should expand beyond our pier and beyond the cruising range of the E.W. SCRIPPS,

to the entire Pacific Ocean, perhaps even also the Gulf of Mexico and other bodies of water. The present administration, in complete cooperation with the ^{present} staff members, has emphasized and ^{integrated} ~~indicated~~ research programs for

study of the sea, its ~~hab~~ inhabitants, its constituents, its *movements* and particularly its relation to man. Up until this point

I believe the Institution has had a healthy and normal growth. It would take far too much time to attempt to point out what has been accomplished. ^{But the important} ~~One~~ thing for us to consider here rather than looking back is rather to look ahead. Where do we go from here? Maybe you can help us to decide. I thank you.

Rabenstein

recalls the man ~~one thing, one little thing, but was intensely~~ enthusiastic about that one little thing. And when we think of that and when we realize the

Prof. Reuello, friends

I've been told that my primary job is to get through ~~with~~ this in time ^{so that} some of you can go & watch the quinions. There are a number of aspects that I am going to mention

educational or training ^{program} at Scripps Institution ^{can be} ~~to~~ considered *From the very*

largest of these ^{our} ~~our~~ educational program is quite outside of our curricular relations, or our relations with our students. To a certain extent it is our educational

problem to educate the general public. *Some one has said*

to educate *admirals* on the desirability of oceanographic research and the national defense, *to educate the fishing industry*

to advance in oceanographic research in that field, and in other very obvious directions. But this is not the aspect of the subject which you expect me to talk

Robertson

about and it's not the one which I shall talk about. Our educational program has many ways in which it

Our policies and our decisions shall ^{even} affect the ^{framework of} Oceanography as a field. ^{our methods} What we do, the curriculum ^{we} devise on matters of teaching will concern such things for instance as our attitude toward unity or coherence of Oceanography as a field. The question of whether or not this is a merely a loose association of conventional sciences ^{gathered together under one roof} or whether it is a field of science an endeavor which ^{has} some ^{unique} distinctive contribution to make to knowledge.

This ^{subject} and some others like it ^{have been considered in} study and publications educational training of oceanographers ^{in fact} which was ^{collected} and published by three of you who are here, and which is probably known ^{to many of the rest of you} also. This study, momentarily

at least, disposed of that particular ^{point} oceanography part, ^{the unity of} oceanography, ^{by} are pointing out that oceanography does have ^{unique} features ^{that} beyond ^{or outside} conventional sciences which in many other ways contribute to it. ^{at any rate} ^{we shall} ^{assume} that in what goes on from here, ^{in addition to these} problems or aspects of our educational program ^{which affect the}

^{of course} wider field, ^{they are} They are/unique problems, problems which are unique more or less to the Scripps Institution and we shall try to investigate some of these.

^{for me} It will ^{be well} I think we need to give you a little more of the history of our student body and its source and general character ^{than Dr. Zippell}

^{was able to do} Until about five years ago student work at the Scripps Institution was largely incidental to the ^{main} research program and still is to a certain extent. ^{but at any}

^{rate the} ^{student body was rather small, when 4 or 5 graduate} ^{students were here it was a large crowd} Since that time the student body of this institution has expanded something like ¹⁰⁰⁰ per cent. ^{which is a rate of growth few} ^{of the collegiate inst. can point to.} whether that's an advantage

or anything to be proud of I'm not sure. In the fall of 1949 and 1950 our student body numbered 54. In the following spring, just a year ago, 48. Last fall, beginning ^{of} the present school term, 1950-1951, it reached its highest peak of registered students of 62. At the moment ^{it is 21} we have 50. It is interesting to find out

^{of} that our present student body of an even 50, 10

Rabestraw

of these are in ~~other~~ ^{other} departments than the department of Oceanography. We are as

I'm sure you understand a graduate department within the southern section of the

University. There are also two other ^{things} factors incidental ^{as}

some of Dr. Revelle's ~~studies~~ ^{studies} as he probably will bring this out at another time Scripps Institution is not only a graduate department of instruction, it's also

a research institution and it's also a campus of the University of California.

of our present student body we have 21 *I have counted up as what I may describe* as active potential candidates for the PhD, that is to say they are in various stages on the course to reach the PhD., having at least signified their intentions.

We have among these, 6, theoretically *real* candidates, that is to say students who have finished their qualifying examinations and have become in the technical sense of the word candidates for the degree. We have also a group who *ought to* be included

among these real candidates although they are *inactive* in this sense. They have

reached this stage ^{then} and have gone on to various things before they have ~~gone~~ completed their final examinations and *their thesis*. Of these there are seven *who are like*

to think of these as graduate students although they are not engaged in

oceanographic work either on our own staff here at Scripps or some other of them

in fact at N.E.H. ~~and~~

and in such other places as Texas A. & M College, *Ches. Bay* Institute, and

the University of British Columbia. It may ^{be of} interest to you to note that out of these

thirteen real candidates for the PhD, 9 of them are probably described within the

field of Physics and Oceanography. That gives you some idea perhaps of the emphasis

between different fields. Something about the source of our student body will

be interesting I'm sure. Since 1946 when our ^{curriculum} program was expanded and reorganized

here and when teaching and educational work at Scripps *really began in the modern*

sense. Since 1946 we have had 9 students from the Navy assigned here as

Navy officers. We had 6 from the Coast Guard, ^{had} we had 8 from the Air Forces.

We had *had quite an interesting* foreign students *and imposing array of*

4 from

Rabestraw

Argentina, ^{after} incidentally also Naval Officers assigned to competitive examinations for their entrance in the Navy. We had 3 foreign students from China, 4 from Canada, 2 from Egypt, ^{one each} 1 from Peru, Ireland, and South Africa. ^{this,} Considering the small student body I think this is quite a large percentage of foreign students. ^{Among our} foreign students ^{or addition to these should} a group who technically speaking ^{are} not be graduate students but have been ^{we added} nevertheless ^{less} uniformly students here ^{less} having come as visitors for longer than really ^{short} visits, some of them having settled down as even ^{independent} as investigators, some of them ^{their own} having obtained graduate degrees, some of them have found here for various reasons for special training. We have allowed these in many cases to attend our classes and to ^{visit &} further learn ^{here to learn} & were sent /about Oceanography, them. Among these ^{visitors have been} students ^{they} were representatives from Portugal, Holland, and the Dutch Indies, from England, from France, from Denmark, and from Norway.

I should emphasize what I didn't say, that

our instructional work is entirely on the graduate level.

instruction with the exception of ^{with} one or two special cases of special students who have been admitted ^{below} that academic rank. ^{now} There are a number of aims or purposes

to an educational or instructional program such as ours. One of these ^{could be} the training of technicians. This I think you will agree with me ^{would} has a major aim if not ^{be} appropriate, certainly not at the graduate level of instruction. We face this problem only in a minor sense perhaps.

We do employ technicians + we ^{ourselves,} have to train them ^{we don't do that of} as a part of our ^{any means of} courses. We do not consider that our primary function is to train workers in the field of oceanography at this level. ^{A second aim} is what has been

called, ^{very} appropriately I think, oceanographic engineering. This means of course something ^{quite} very different from mere civil engineering and the construction of piers and other agencies which will stand up against the ^{buffing} of the waves.

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Oceanographic engineering in this sense is a broader term and means really the applying of oceanographic knowledge to practical purposes, includes even biological fields of activity. Next there is training for careers in research at the highest level. To these ³ we ought to perhaps add another, a temporary one no doubt, emergency ^{short} courses, which have been offered here at Scripps Institution during the last war and which ^{may} we have to face again. It's a real problem and so we shall ^{do whatever} ^{we think} ^{our} responsibility dictates. *Now in* 1946 as I indicated a moment ago, the whole ^{curriculum} ~~course~~ here at Scripps Institutions was reorganized and expanded. At that time *was laid out what was* I feel sure the first really coherent curriculum of oceanographic training. This was planned *largely by Dr. S. H. Duntson* and it emphasized the Masters Degree, the ~~curriculum~~ for the Master's Degree was considerably strengthened and this was done in an effort to fill what were very obvious vacancies in openings for oceanographic workers at that time. These vacancies to a considerable extent still exist. It may be interesting to notice what happened as a result of this. We ~~had~~ ^{have} granted here at the Scripps Institution since 1946 some 42 Master's Degrees. *If I have been able to collect the records correctly* Prior to 1941 there were 5 Master's Degrees granted here in the field of Oceanography and the figures I am going to give you now apply to degrees designated in the field of Oceanography. ~~Before~~ Between 1941 and 1946 two were ^{awarded} ~~granted~~, 1948 14, 1950 there were 8, and the present year up to the present time, 9 *already* before the end of the current year. *Before I go on* it ought to interesting to note what has happened ^{historically} in the way of Doctor's degrees here. ~~Before~~ Prior to 1941 I have found evidence at least that 8 degrees designated in the field of Oceanography. I am not sure that this is complete. I couldn't be quite certain of it. From 1941 to 1946, 2 degrees in ~~the field of~~ Oceanography were awarded and since 1946 there have been 6, a total of 16. All of these and Master's Degrees, if I may go back to that just to see what has happened to these Master's Degrees that have been granted in this expanded curriculum since 1946. Thirteen of these have returned to

Rabestraw

the Armed Services from which they came to us. Four have returned to the foreign countries from which they came, 3 of these are continuing graduate work, as at the moment ^{present} regular registered graduate students, 10 of them have become inactive in student capacities and have ^{employed} ~~are now~~ full time in the Scripps' Research program. Another 10 ~~have~~ ^{and} are now similarly employed in full time oceanographic positions elsewhere. So that out of the ^{total of} 42, as time ^{includes} ~~indicates~~, 10 of these have been available for oceanographic positions at other institutions than our own. This does not come up to the expectations of this degree as a source of oceanographic workers to the extent which was originally envisaged. Our present plan is to ~~deemphasize~~ the Master's Degree and to concentrate more particularly upon the PhD. This comes into our picture in our admissions policy. We are ^{reluctant} ~~allowed~~ now, ^{not} generally to accept candidates for admission who say that their intention ~~is~~ is merely to work their Master's Degree and go no further. We feel that we should take only those whose ambition at least, and such evidence as we can get of their ability, ~~to~~ go further than this. *We know very well that we cannot concentrate exclusively upon the PhD. nor do we intend to do so.* The Master's Degree will always be a degree which will be granted to many students on the way to their PhD's, ^{this} ~~which~~ we feel is entirely acceptable and proper. Furthermore ^{many} ~~none~~ of our students ~~are~~ sent to us, particularly those from the armed services, ^{are not assigned here} for a long enough time to become candidates for the Doctor's degree. In many of these cases they have been able to obtain Master's Degrees and we have no intention of interrupting this practice. However our present feeling and policy is to try to concentrate upon the highest level, ^{as being} ~~of~~ the PhD. degree. Now as a research institution, as we conceive ourselves to be primarily we feel that we are particularly fitted to carry on ^{graduate} work on a plan which may be described as an apprenticeship plan. That is to say we are now carrying on a rather extensive research program. Most of our graduate students/are ^{indeed actually} ~~truly~~ employed in that program. Others who are not actually employed get an opportunity nevertheless to participate in it ^{less formally} ~~as it was~~ formerly. This makes them do a considerable ^{extended} ~~extended~~ ^{we conceive} ~~you can see~~ in the field of general research and this is as ~~you can see~~ a strong point in our educational program and policy which we intend to continue and to strengthen.

ROUGH DRAFT

-15-

This does not mean of course that we avoid entirely the giving of formal courses because I shall show you later on that we have laid out what we think at the moment at any rate is a fairly adequate array at least. In trying to offer our graduate work on a sort of apprenticeship basis, we are fortunate in the requirements which the University of California lays down for the Doctor's degree. They are sufficiently broad to enable us to do this. The University ~~has~~ ^{does} not stipulate its requirements for the PhD in terms of courses and course credits, fortunately. I know of one institution ^{which} is very materially handicapped in offering the Doctor's Degree in oceanography because of what seems to me an inequitable requirement of 96 hours of course credit for the PhD degree. ~~Therefore it makes~~ ^{that makes} it necessary to pad up a curriculum with a lot of courses and see that students take them. We do not feel that we are inadequate here to do a good job of oceanographic and engineering. Our staff is by inclination/background and training not to any large extent either interested or capable of this. We shall probably never try on a large scale to develop the practical applications of oceanography other than as becoming more or less incidentally on the kind of graduate program ^{must do} I've just described. We know of course that ~~we~~ some of this, none of these things can be categorically divided into divisions, ^{after all} particularly ^{our responsibility} toward our students from the armed services makes it necessary ^{for us} to offer practical oceanographic work and to lay considerable stress upon certain types of applications to be sure. We feel that we are not doing the best job, the kind of job that we should towards our students from the armed services. We do believe that we can serve them best by offering ^{to} even such students ^{whose interests} that are largely practical, by offering even to them an insight into what research in this field really involves, and to inspire them enough with the advantages of ^{pure} research in this field as well as in other fields of science so that they may go back to their stations, ^{what} wherever they may be with an appreciation at least of the values of fundamental science even to those activities which are largely applied.

ROUGH DRAFT

-16-

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However we do believe we must offer
to our
service students more opportunities for practical work. We also have a
strong feeling that we should hold and strengthen as much as we can our current
relations with foreign students. We are rather proud of our record, we think
it is rather good ^{with} our foreign students and that our institution is well adapted to
handling students from foreign countries and I hope that if we can expand in any
direction, we don't want to expand much, ^{over the} present size of our
student body, we can do our expanding such as it is in that direction. ^{now} There are a
number of ways in which our work involves of course our relation to the general
University program. Dr. ^{of Bell} a moment ago mentioned ^{our} relations
to the ~~the~~ principal sections of the University. I may say from my ~~experience~~
experience we must have much less contact with the northern division than he
has outlined. I don't think we have enough direct contact with the northern
division. As ^a part of the southern section we are occasionally embarrassed
and limited by the lack of direct communication with the northern section. This
I realize is completely an administrative problem to settle between the graduate
division of the two sections but we feel the pinch often times because we do
get students here from the northern section and the difficulties of transfer
and so on are real with us as certain ^{ly} they must be in some other departments too.
We are a little bit hazy ^{I think} in our own minds, ^{I know} I am somewhat, as to what our responsibilities
are or should be toward the general University educational program. We have
^{regarded ourselves} perhaps quite properly as an institution which
is engaged almost exclusively in professional training. If that's the case ~~the~~
our responsibility is to the field of oceanography primarily, to the field of
general education to a much less extent. ^{Partly of course} this is a result of our
isolation down here. ~~We are~~ isolated ~~and separation~~ from the rest of the ^{our} proper
campus has within it elements which strengthen our program and ^{other} there are elements
which weaken it, obviously ~~by~~ weakenings of course because of the inability of our

Rabestraw

ROUGH DRAFT

-17-

students to take advantage of other types of work within the University. One of the most obvious examples of this is our lack of any opportunity for our students to get any training in a ^{foreign} language. One of the great hurdles which our students have to get over, and I'm sure they do in other graduate departments too, ^{but} particularly here, is to meet these language examinations. We can offer no help to them here in any formal way, and that is too bad. It would be an advantage in some ways if we had the opportunity to make use of the facilities of certain other departments also, which our students could profit from. On the other hand our isolation does give us a certain amount of autonomy down here, it enables us to keep our house pretty much as we like to keep it, and Dean Knudsen here is very cooperative in allowing us to do pretty much as we like as long as we don't break too many of the University rules and get him into trouble, ^{we} and try to keep ^{we know that} him out of that and ourselves out of trouble too. However if we were on the Los Angeles campus ^{would} we have to do more of a part in the general educational program than we do now.

We have done a little in this direction. A year ago we offered on the Los Angeles campus a survey course in oceanography. This was ^a course within the meteorology department at that time. Now this course is ^{being} reorganized and will be offered every other year on the Los Angeles campus as a course in Oceanography and by the members of the staff of Scripps Institution. This will do something to ^{hold up our} responsibilities I think ^{towards} with other fields. We don't regard this as a recruiting program on our part. We have no desire to go out of our way to recruit. We think we'll get all the recruits that we want without ~~without~~ beating the drums for them. Our educational program also involves relations with other departments, than the department of Oceanography. As I indicated before about 25 % of our present students body are students in other departments, and in this case entirely in zoology and micro-biology. This ~~Wxxxxxxxf~~ thing will doubtless continue ^{even} ~~xxxxxxx~~, maybe increase. Our problems toward these students are

Rabeatraw

not very much different from our problems toward others excepting in content. They get their degrees under the auspices of the ^{appropriate} departments on the Los Angeles campus. We serve either individually or collectively as agents of those departments and handle ^{the machinery} ~~them~~ to a large extent here. We maintain in ^{own} our/offices an informal substation of the registrar's office at Los Angeles and try to ^{keep records of} all students ^{not only} ~~other than~~ department of Oceanography but others too. Most of our students, I believe I mentioned this before but I want to mention it again, most of our students are actually employed in our research program. We are able, fortunately we feel, to offer these opportunities as student aid. Our department is fairly well supplied with research assistantships but we can also work in technicians and other types of workers on our research program. Our general policy is towards making ^{first} ~~this~~ semester's students ineligible for such appointments although in some cases we ^{wave} ~~will~~ ~~make~~ that rule too. We feel that our first semester course is one which requires the student almost the whole time of the student's attention to orient himself within the field of oceanography. ^{This fact} of employment of students upon our own research program, introduces a ~~problem~~ question which perhaps ^{I ought to keep dark but I'm} ~~demonstrate~~ ^{not going to. I'm going to spread out} our ~~lesson~~ ^{for} what it may look like. There is a University rule which prevents the student from getting any academic credit for work which they do by way of employment. This is embarrassing to us. I don't know exactly what we shall be able to do about it but I will confess to you that we've probably overstepped that rule to a certain extent but I don't think there's anything we can do about it. ^{Somebody is going to ask me} I'm sure, something about the actual courses which we offer, so I'm going to close ^{by giving you a little closer view of our} ~~actual~~ ^{actual} curricular offerings.

Our students of course come to us with, in ^{all cases,} ~~practically~~ no background whatever in Oceanography as a separate field. They ~~are~~ come to us as ^{major} ~~nature~~ students in one of the

sciences or in engineering or in mathematics which our general requirement is. Because of the fact that undergraduate courses are offered almost no place, in only a very few places now, ^{can any of these} students get any direct contact with the ^{therefore} content of oceanography. We have to depend upon our own first semester for such orientation. Our first semester consists indeed of a set of four introductory courses, the intent of which is to furnish the beginning student with a general view of the whole field of oceanography broken down into ^{what} ^{concerns} which we can see to be the four principal divisions, physical oceanography, biological, geological and the chemical aspects. This constitutes in most cases the first semester course for ^{all} our beginning students. These courses are ^{invariably} at the upper division under-graduate level and are ^{not therefore full blooded} graduate courses in our catalogue in the 200 series; ^{these are 100 series} courses. These ~~may~~ be followed by a group of courses which are also ~~under~~ upper division under-graduate courses. ^A ~~of~~ course in vertebrate biology and oceanography, a course in bio-chemistry, a course in ^{marine} micro-biology, ^{a course in underwater sound,} a course in statistics, particularly, a ^{short} ^{practical} course in chemical methods, and a course which we designate special studies in oceanography which ^{covers a} large number of different possibilities principally ^{minor} research at the upper division under-graduate level which for certain cases in which students are not qualified to take the more advanced research designated by ^{later} our ~~lower~~ course 299. In ~~considering~~ the second semester and following that courses are offered in such fields as physical oceanography, an advanced course in physical oceanography, following the first semester, a course in waves, a course in tides, a course in hydro-dynamics, a course in hydro-paleontology, a course in marine sediments, a course in ^{designated} special topics of oceanography ^{the content of} which is changed from year to year which enables us to adapt this course to the presence of certain visitors for instance, ^{or} special topics which we ^{may want} ~~have made out~~ to experiment ^{ment} with for a given year. This last year we made this course very practical, ^{trying} tried

ROUGH DRAFT

20-

Rakestraw

to emphasize as far as possible some of the military applications of oceanography
a course is ^{offered} ~~offered~~ in problems of general oceanography which is ^{really} a seminar course
which has proved to be very valuable, taken by our students after their second
year, a general seminar and lastly an inclusive course in research in oceanography
which covers all of the advances of oceanography and may of course be registered
for repeatedly constituting in many cases the total registration of advanced students.
This constitutes our curriculum and I hope I

*Revelle**R*

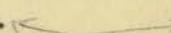
and of our educational program. Professor ZoBell's talk raised several issues in my mind, at least, that we need to discuss to considerable length. I hope we will be able to do that in the succeeding days of the conference. I'd like to take issue with one minor point that he made. He said we had only 14 academic staff members. We have only 14 members of our faculty, but we have also some 20 members of our academic staff who hold research positions. These come under the category of University academic non-faculty positions, and representatives of that group are here tonight in addition to our 14 faculty members. Actually many of our academic non-faculty staff members do a good deal of teaching and teach formal courses which are listed in the catalogue even though they do not hold faculty positions. We like to think of ~~ix~~ these research workers as being equivalent in rank and purposes to ^{ways of} nearly all/members of the faculty. They're not on the ladder of academic succession and are not members of the academic *staff*, they really are at a considerable disadvantage within the University structure. As to the problems raised by Professor Rakestraw, it seems to me these are two, what should we do educationally and what can we do. I had a long discussion the other night with a man who said ~~who~~ said the purpose of the University is the education of young men. My feeling is that this is a very limited statement of the purpose of the University. Certainly the primary and in fact perhaps the only purpose of the University is education if it's defined in its broadest sense, as the advancement and dissemination of knowledge. Professor Rakestraw pointed out that this covers a great many things. Certainly it covers the ^{the results of} dissemination of/research by publication, by talking about it. It covers such conferences as this; it covers working with many kinds of people throughout the country and throughout the world on problems of man's knowledge of the external world., or of himself. Here at Scripps Institution our tradition has been that of primarily a research institution and our staff has been recruited largely from people who have preferred research to formal teaching. This certainly raises difficulties when we attempt to work out an educational program in the narrow sense of the ~~xxxx~~ term, the

Reville

education of young men. Our faculty, it seems to me, and this is a controversial statement, can teach most effectively by the apprenticeship method as Dr. Rakestraw pointed out, By having young assistants and collaborators working ^{full time} with them on problems of research. As Dr. Rakestraw said, there seems to be a great need for oceanographic engineers. We don't mean by this ^{term} in any way to belittle the profession of engineering or the kind of man who could be an oceanographic engineer. As I see it engineering means the application of oceanography to practical problems. An engineer, to me, is a man who brings every facility that the human mind has to bear on problems somebody wants to solve. Generally he works on problems that somebody else wants to solve. The research worker has the great advantage of working on problems that he himself wants to solve. This means that a research worker can have a much narrower training, a much narrower education. He doesn't need to be able to handle the wide variety of problems that other people think of. He only has to worry about the very few problems that he himself thinks of, and to know how to tackle them. So in giving an engineering education we must be prepared to give a wide educational base, whereas in giving apprenticeship training for research each faculty member really only needs to teach one thing ~~xxx~~, that is how to find out about the external world within some narrow field. We have in the present world crisis of course a very special problem and that is the training of people in uniform. Oceanography has many applications to naval problems particularly and it is my feeling that the training of naval officers in the practical application of oceanography to naval problems is something which must be done if oceanography itself is to remain healthy and to pull its full weight in the defense of the country, because these officers sooner or later will be in positions of authority where they can make sure that oceanographic knowledge, knowledge of the sea, is actually utilized in military operations. This will give whoever utilizes the environment to the best advantage gains a very real benefit in a military conflict. It seems to me that it's necessary to train naval officers in the military application of oceanography. It can be said, and often is said, that this training can be given somewhere else, why given here at Scripps where we are doing primarily research. I think the best answer to this

Revelle

statement is that research results are the important results that need to be applied. Let me sight an example: In Korea a few months ago a very real problem arose about the distribution of floating mines. Now this problem can be attacked in two ways, by making a map of a current in the sea of Japan and trying to ~~get~~ ^{make} some guess as to which way the mines would drift. But after all what is the value of this information. Suppose you know that they drift from north to south, what can you do about it? On the other hand we have recently found that there are in the sea lines of discontinuity, that is this has not been found here at Scripps but is something that has been developed by oceanographic research. We have recently found that there are lines along which floating objects accumulated, lines of convergence and that these can be recognized in various ways. This is a very recent research result. This is the very thing that can be applied effectively in avoiding mines in Japan and in detecting them and doing something about them. So that the best kind of military training is intimately involved with research and for that reason it seems to me personally that this is something that we should do. But it certainly is a far cry from apprenticeship training in research. Faced with, as I see it, these two educational problems, what is our responsibility toward the people of California, of the United States, and of the world and what can we do effectively? I'd like to throw ^{open} the meeting ~~xxxx~~ now to general discussion and to ask for any comments or any ideas which any of you might be able to bring to bear on this problem. I was talking to Mr. Cox before dinner. He had some very definite ideas and perhaps he could lead off the discussion.

~~Myxxxxxx~~ ^{Cox} Roger that's a dangerous thing to do.  You ought to know me better than that. It's a great pleasure for me to be ~~there~~ and I hope all my associates back home are as deeply honored as I am that I was asked to come. I do have some definite views on this subject from the point of view of one ~~xx~~ ,oceanography, Of all our basic human efforts, agriculture, water supply, strategic minerals, power is one of our greatest. I'd like to review briefly perhaps for some of you the history of the petroleum industry so that you'll understand what's stirring around in the back of my head. The Semarians used petroleum to a slight extent a couple of thousand years before

copy

Christ. The Romans and the Greeks dug for oil at Devil's in Egypt and used it. And the people between those two times used petroleum. The Chinese used it, I don't know how far back. And it was used off and on in various ways up until Colonel Drake built his well in 1859 but the petroleum industry as a power industry really dates from 1859. And it has grown by leaps and bounds as one might expect where you can make rapid profits. The initial people in the petroleum industry were not scientists and they didn't use science until about 1910, Even though *Keith Terry* in Canada expounded the anti-climate theory as a kind of trap for the accumulation of petroleum a couple of years after Drake drilled his well. But by 1910 ideas of coal and shortly afterwards ideas of coal. And the industry employed geologists in great numbers. And they covered the U.S. and mapped all the surface structures they could find wherever they were with the sub-surface they found oil ~~was~~ ^{fields} at the time of the accumulation had been and they had . Along about 1925 or thereabouts they just about reached that rate of finding those surface structures, geologists began to find as ^{primary} an oil finding method on the surface, and they developed sub-surface ; in other words you can dig some wells, the same thing you did in the service which is essentially correlation and civil engineering. Then the physicists came along. They introduced into the Gulf Coast and started measuring density differences/^{at depth} from the surface and picked up salt and began bringing . And continued to maintain the rate of discovery necessary to supply us with the necessary petroleum to run this economic machine of ours in peace and war. The industry has experimented with all, I think, of the 20/^{odd} methods of measuring matter, to try to find new methods of oil finding. Because in 1937 with only 2 or 3 years exception our rate of discovering new oil fields has been declining. And of all statistical methods that you can think of, that probably is the best guide to how our reserve stands. I don't care what you found 10 years ago, or five years ago that you added to by extending your drilling, you haven't found any new oil. You've got to find more tracks. Up until about 1940 all of the geological and geophysical work /^{practically speaking} was directed toward these structural type tracks. Accidentally over the years we have found a few tracks which are made up of wedges of sand interfingered with marine shales

. And occasionally somebody poked down a wild cat well, just stuck ^{it} into a coral

dot

reef buried and sealed and found ~~maximal~~ an oil field in that and these became
 tracks tracks
 known as stratigraphic ~~tracks~~, interestingly enough they now call them strat ~~tracks~~.

Hangover perhaps from the pioneers of the industry. The fields that have been
 found that way, we might name a few to orient you if you know your oil fields,
 Esethis³ → a big field, Burbank, not a bad field, Redwater and a whole string
 of them brought into Canada recently and so on. Excepting for the Canadian finds
 which have been larged by Geophysics and some geological interpretations, most
 of the fields were found accidentally. Now there is every reason to believe
 geologically that there is as much oil in the stratigraphic type ~~tracks~~ tracks than we
 have found in structural type tracks. But at the present time we do not have a
 method or methods that will find as many of these stratigraphic type tracks.

It is absolutely essential if we're going to produce oil for any long period of time
 to maintain our oil reserves and hence find a new oil finding method and improve
 our old methods. Now that is research. It is equally important that we find those
 new methods quickly. Some time ago, several years ago, a few of the geologists in
 the industry were thinking ahead and suggested to the American Association of
 Petroleum that they do something about this and that they do something
 about their problems, figure out which one was the most important and come up with
 a report which they did. Dr. Shephard W. Loman^{was}, chairman of the research committee
 at the time this was done. He came up with a program . The idea
 behind
 of that program was simply this, that we search in the recent sediments, and he was
 thinking of primarily nearshore and shell sediments. In the recent where you
 can make positive correlations, and interpret the sedimentary forms, the little
 facies or sediment type changes in space and do it accurately and tie it in
 with the environment and the environmental criteria. That/^{project} became known as

and was recommended ~~maximal~~ by the American Association of Petroleum
 through the American Petroleum Industry. The American Petroleum Industry
 accepted it and spent I think an undue amount of time searching around when there
 were only two institutions in the country that could handle it. And placed it finally
 at the U. of C. And it was placed here for the obvious reason that you have splendid

Cox

basic science background in all the sciences which are applicable to oceanography and that we have the assurance that this university would give the assistance from those pure science departments to the application of oceanography, oceanography which is engineering in a sense and that the institution here at Scripps, institute excuse me, had done such outstanding work in all the fields and especially in marine geology and they have a man now who is I think the acclaimed leader in so the project came here.

In the course of the last few years one company started off a project of the same kind and four others followed suit and there are rumblings of some more of them going to start soon and also have their little projects. Now those are little research groups, they're not engineering yet. Those little research groups, if we multiplied the number of men it takes to run one of those research groups, by five companies you have quite a sizable group, If you multiply it by the hundred contributors, API research, you have an enormous number of people. And if you take one report which I have in my hands now and turn it loose on that API crowd You're going to have ~~xxxx~~ to call or obtain 100 or 200 next year. It is hard to believe that to make good regional geologists trained in sedimentation they must have basic training or have the benefit of basic training in sedimentation, marine sedimentation. Our text books ~~xxxxxxx~~, as every geologist in this room knows, ^{are full} of whooey and not spelled "whoi" But if we had more "Whoi's" and more Scripps' we might be able to do it. The question which I would like to put to you gentlemen and especially to the administration of the University of California and the organization of the Universities at Whoi is how in the devil are you going to provide the necessary trained men: for the landlocked universities that must train a better grade of geology for stratigraphic tracks type of oil finding, provide the men for research at this institution and at WHOI and any other institutions that you can get ^{together} the money to found around the coast in England or the Gulf and supply the chaps that you don't want to give the PhD's to I suppose to the industry. Now how are you going to do it? I don't see Roger how you can do it unless you perform your major function to the people of your region, of the nation and of the world of combining both research and education. Now I agree with you that you'll do a better job if you can teach two or three at a time. If you do a

good enough job on those two or three they can teach the same number each, the cover system and your logistics begin to work out over a period of time but they're not going to work out in the period of time that will come from this API project. You've got a real problem.

Remille Thanks very much Ben. Does anybody want to answer this audible statement by Dr. Cox? Dr. Redfield you're an authority on the educational training of oceanography.

Redfield I can only answer Mr. Cox's question in the affirmative since you asked me an unfair question. I might make a few remarks which would be pertinent to this discussion from the point of view of, shall we call it comparative physiology. I haven't been in comparative physiology but physiology is one stage of my career. In other words to speak as a representative of the principal competitor of this institution on the possibilities of an organization of this sort compared to the possibilities of an organization such as we have at *Wash. State*. Now the subject which I believe we are discussing tonight is the relation between an oceanographic institution such as Scripps and a university such as the U. of C. You can't discuss that unless you have some agreement as to what you mean by a university and by oceanography. I'll not attempt to define either of those but I'd like to make a few remarks along that line. In the first place with regard to the nature of the University I suppose I gave my concept during my impressionable years when I was connected actively with Harvard University. I went to Harvard in 1910 which I believe was during the first year of Mr. ~~Lowell's~~ ^{Lowell's} administration. I think the thing which perhaps impressed me more about Mr. Lowell than anything else was his very successful opportunism in doing what seemed to be the desirable thing to do, whether it fitted into any recognized pattern which existed in the university or other universities or not. For example I had ~~many~~ ^{close} contacts with a department of Physical Chemistry which was established in the medical school which I think was quite a unique experiment and which has borne very fine fruits and still persists as a much greater venture than it was started as. And then there was a Department of Physiology in the Harvard Business School. What that meant was that you had at Harvard a very unique individual named Lawrence Henderson who actually started both of these ventures and Mr. Lowell saw that the important thing was to profit

Redfield

by the opportunity which he had in having Dr. Henderson in the university. And he profited from the fact that Dean Dowlen of the Business School had on the one hand means at his disposal greater than other departments of the university and also had an appreciation of the opportunities which Dr. Henderson offered. And so Mr. Lowell did the things which seemed to be the opportune thing to do from the point of view of the present stage of development, of knowledge, of opportunities for gaining new knowledge. And I mention that because I think that oceanography is a subject which nobody knows quite how it fits into the educational system. That is the problem which I think you have asked us to discuss Roger. Now with regard to oceanography, the opportunity I think is merely this. Extending out here for, is it 5000 miles, there is the biggest chunk of the notable unknown which exists I think this side of the hereafter. And is what I presume an opportunistic thing. You have here an organization which is prepared at least to take a nibble at that chunk. Now with regard to the abilities of this institution to develop this subject in comparison to that, for example, which we enjoy at Woods Hole. I think it is worthwhile to point out to this group, which is to some degree at least heterogeneous, something in the difference in the idea which existed in the establishment of the institution at Woods Hole. You are aware and it has been reviewed for you, more or less the history leading up to this university department of oceanography which is

*missing Part**Reel IV*

and carried out the rather expensive operations which oceanography entails and so an institution was founded which had practically no permanent staff, drew entirely on university professors and similar people who would come from time to time as their duties permitted to carry on the work. That concept proved to be fallacious, at least in this. It was believed by the founding fathers that one could not hold a group of investigators for twelve months of the year, half way together in Woods Hole. Circumstances of the war completely dispelled that illusion as you know. There still is the problem of finance. It is in my line a very great question as to whether a private, a strictly private institution, can be supported at Woods Hole to do the effective type of work which is involved. The solution of that has been to resort to a degree which I think is unfortunate to support by contract primarily by the government. But I think the

Redfield

important thing which impresses me more and more and makes me very unhappy as I compare the institutions is the very great success with which this institution apparently has been guided during the war, and the years since the termination of the war, in its policies and I am inclined to think that in the long run we may find that the stabilizing factor which comes from very immediate associations with the University will be the determining things in making for the relative success of these two institutions. For example we have at Woods Hole at the present time/only 3 persons who/can obviously brag are full time professors which you have in this institution. Three persons' time/are given almost entirely to administrative duties. We have the problem of making our positions look attractive to the young men who wish to know about the security, the advancement, and factors of that sort. The people who wish certain prestige that go with university positions compared to that which we can offer. It is for this reason that/^{I feel}this is a very interesting experiment and a very promising experiment which you are carrying on here.

Revelle Thank you Alfred. Any further discussion on this problem of education? Oceanographic education. Dr. Merriman do you have any comments you'd like to make?

Prof. Revelle I'll try but the accumulation of

Merriman plus a dose of air, or should I say California air and sun I've had today, the delicious dinner, drinks, I'm not altogether certain

that I can express myself very well. I'd like to take this opportunity certainly to thank you for having me here. I think that visitors from afar try to get a lot more than they give and I have no doubt about that. I'd like to talk about some of the things that Dr. Rakestraw spoke about first of all. One of them, the matter of teaching at the undergraduate level and I think he said it was not your desire to recruit PhD. students, meaning as I take it that you have aplenty as it is. Is it not possible on the other side of the fence, however, that oceanography as a science is insufficiently advertised to the young undergraduate, and that we do well to advertise it a little bit further and that if you don't want larger numbers that other institutions can handle them or perhaps the quality of the PhD students can be increased and improved on. I am delighted to hear him say that you wish to concentrate on the PhD degree. Surely our greatest lack, it seems to me, in oceanography

Merriman

in these times is the number of people who are qualified with broad basic training and have gone on to the PhD degree. It seems to me that we want more of them even if you don't want them here~~x~~, for the time being. One question I'd like to ask him--I understand, or think I understood him to say, you don't want to train the oceanographic technician. The only person I want to ask^{is}/if you don't who does? I really would very much like to know the answer to that one. And then the other thing I'd say is, listening to the historical part in the earlier part of the evening--I don't know what the answer to this is at all--it's the increasing spiral of science I suppose in these times--. Here this afternoon we see your boats, we hear about the growth in the number of your boats, we hear that another one is on the way for you, we all know of the rapidly increasing techniques which make for a vastly increased possibilities ~~of~~ ^{for} collection of data, and these then outstretch it seems to me the ability of the scientist to handle that material. What is the answer? You're right, it seems to me, in saying that you have to concentrate upon the PhD student but wrong perhaps in saying that you don't want anymore.

Revelle I thoroughly agree with you Dan that we should recruit and we have a policy of doing that by listing high school students and students who are undergraduates in college to come down here and live on our ships or work in our laboratories. We pay them ^{virtually} ~~practically~~ nothing. I think we pay high school boys \$50.00 a month and undergraduate college students \$75.00 a month. We do give them board and room in town. This serves our purpose of trying to enlist bright young men. ~~R~~

Merriman Probably the best advertisement possible I would think.

Revelle Walter Munk, for example, was one of ^{these} ~~this~~ bright young men. He's certainly a shining example of the virtue of this policy. I think what Dr. Rakestraw meant ^{was} that we are rather embarrassed by the number of graduate students we have because of the small size of our faculty but certainly we would like to have a larger number to choose from. And the recruiting business does just that. We would like to bring the possibilities and fund of oceanographic research to a great number of young men so that we could have the opportunity of choosing those who are most promising for further education.

Rakestraw May I say--I quite agree with you. I didn't mean to imply that we shouldn't recruit

Rakestraw

in oceanography. I think what I really intended to say was that this particular effort of ours to give a course on the L.A. campus wasn't primarily for recruiting purposes but we certainly want more PhD material if we can. And I think we can stand more. I don't think we want to cut off this supply. I would like to say one thing more about this ^{matter of} training of technicians. I wanted to imply there that I didn't think we should arrange our curriculum or our formal offerings for that particular purpose. I don't think that that is justifiable at our academic level. But our program here has a sort of incidental educational result which does bear upon this question. We employ quite a large number of technicians. Those employees of ours are getting educated at the same time and many examples can be pointed out right now of these young fellows who have found very nice careers and are planning them all the time. Really graduating from our research program into positions elsewhere. We are training technicians in that sense and I think that's a perfectly sound thing to do. We can't help but continue it whether we want to or not.

Rivell Our current rate of turnover in technicians is about one every three months.

Redfield Isn't the training of technicians a very minor part of this whole problem?

It seems to me that if we can get a person with any sort of education it takes very little time to teach him the special things that we want him to know. In the first place our techniques are not very completely standardized as yet. The real problem it seems to me goes much further than that, it is to call the attention of the college student to the subject of oceanography and in that connection it is a subject that has very unique values, as I think Dr. _____ can tell us because there is no subject that I know of in which the applications of physics and chemistry and biology which the college student requires is so clearly brought out in some concentrated way. So I feel it is a much more important part of your function in the university to present in a general way the problems of oceanography to the undergraduate than it is to train the technician. And it is of course in that way that you will recruit better candidates for your higher degrees.

Rivell You've touched on what I think is a very important aspect of this business that because of the nature of the science it has a value to the whole liberal arts

Revelle

curriculum or may perhaps should have value. It could be a good humanistic subject.

One interesting aspect of the discussion to date is the geographical distribution. I

notice that everyone who has talked has been on shall we say this side of the salt.

Is there anyone down at this end of the room who would like to say something? Dr. Russell.

Russell

As an alumnus of the University of Calif., a university professor, a member of the Navy at present with tenuous ties to Scripps, giving a few lectures out here, I occupy somewhat of a unique position in this group. I would like to take issue with Dr.

Rakestraw's thesis that the primary function of the Institution should be the training of PhD's so far as education is concerned. It seems to me that Dr. Redfield has put his

finger on the unique characteristics of oceanography, that it is a blend of a number of sciences directed to the study of the sea. That Ben Cox's problem can be solved in large

part, if geology graduates take a Master's Degree in oceanography, that our need for

biologists who understand the sea solve a large part if biology graduates take a Master's Degree in oceanography and the same way with the other branches. I think at the same time

if you expand your Master's Degrees more, you will find that you have a much larger group from which to pick your top PhD candidates. I would hate to see the Scripps Institution cut down on their Master's training in general oceanography.

Hutchinson

I would very much first like to express my appreciation for being here and perhaps make a few remarks to the experience of two sorts connected with the choosing of general supervision of a group of graduate students from a rather large range of biological

subjects. I would first like to implore you to take Dr. Rakestraw's views so deeply to

heart that you'll never depart from them in keeping the group small. I think that if one

has certain people and compare to say 90 people the quality is probably something like the inversed square of the ratio. In this particular case it would be 9 times as good

as 30 is to 90. I think that anything over 100 just goes astontotically haywire and you

won't get anything worth writing about. Therefore if you wanted to get a whole lot

of foraminiferal ^{ecologists} ~~sponges~~ or a whole lot of monsters of oceanography, academic rather than

fundamental sense of those words, it would be well to spread the training out to a large

number of additional institutions throughout the coast line. I don't think that that is

absolutely unfeasible. I find it awfully difficult to believe it is really in the national

Hutchinson

interest to have 200 ^{my}foramiferal ~~xxxxx~~ ecologists. It seems to me that is sacrificing the time and energy of the/^{number of}people training them to permit oil companies to cut each other's throat in this matter. A matter of that sort is exceedingly serious for the following reasons. A good many of us and become exceedingly worried about the caliber of graduate students who present themselves for admission. This year has reached an absolutely low level. Before the war in the Laboratory at Yale, there were approximately 60 students wanting assistantships every year. This year 17 applied and there were 2 who were obviously worth while having and I think they were communicated with telegraphically the moment we knew about them. One accepted, one came and looked us over and then very wisely travelled across the continent westward. I don't know what the solution to this is, it may be merely that you draw the good ones off and it doesn't matter from the national point of view, it's just a little disheartening for Dr. Merriman and myself. I don't think that's the explanation. I think that possibly there is a set of explanations that are partly concerned with your atomic physics at the moment, partly perhaps due to certain difficulties in connection with a lot of people running off into medicine for perhaps national reasons or what they think are national reasons. But that is a problem that has got to be faced and probably concerns not only oceanography but other biological and non-atomic physical sciences. I think on the fundamental level there is a very real problem which probably concerns everyone here present, in one way or another.

Revelle Thank you Dr. Hutchinson. I think this discussion could probably be continued for a good long time. However we have planned a good hard schedule tomorrow and I notice that the hour is already well past the time we promised to let you all go to bed. I therefore propose that we adjourn for this evening and meet again at 9:00 tomorrow morning. We will have automobiles here in time to transport all of our guests who are staying at the Beach Club and Mr. Kellogg's house to the Scripps Institution, about 10 minutes to 9 tomorrow morning. We'll plan to continue with this discussion as well as the other questions tomorrow morning, tomorrow evening, and Tuesday morning. I again want to say how very pleased I am at seeing you all here and I think this is the ^{unanimous and}enthusiastic opinion of all the members of the Scripps Institution family. With the interim parting words I propose then that we adjourn until tomorrow morning.

point out at the risk of

Israel

it really isn't necessary in the field of oceanography and we shouldn't be embarrassed by the fact that ~~ix~~ we do have this kind of program of research. We are about in the same position as the astronomer. In oceanography we have an expensive facility, namely the ships and we must program the work to point where we can make the best possible use of their time,

to chart

The preparation I have made for this has been mostly to write out a list of things that are going on here in physical oceanography and I shall try to indicate some of the fine knit problems that remain to be solved and also what the applications are. The major program, the marine life research program, which however has very large sections, a very large part, devoted to physical oceanography. The current branch ^{turn} to the surface and this in/constitutes, the larger marine This ~~T~~ program is used in the , major user of ships and has attempted a synoptic survey, survey of the waters off the west coast from the Columbia river to lower California. And has accumulated a vast amount of data on temperatures, salinity , as well as biological data. ~~For the benefit of~~ ~~For the benefit of~~ ~~some of you who~~ ~~from the~~ ~~salinity~~ temperature and salinity are not familiar with the techniques of oceanography , ~~salinity~~ it is customary but impossible to calculate the function of depth it is customary to convert that into currents by means of a theory that was developed many years ago. The major effort of the marine life program is to determine wherever current pushes the water together so that the ^a /up but unfortunately the classical ^{pths} move theory assumes that there /so that the study of is more or less ^c taken on at the present time. It is accomplished indirectly and a good theory ~~of the~~ of the water is badly needed but perhaps will also not be possible to turn up merely from these temperature and salinity. A much effort continued for a longer period of time, really Dr. McEwen's personal research, of the large edges which form off the coast here and probably do have a connection with . This work must be continued and expanded in my opinion. One of the major developments in the theory of oceanography has been the recent work at Woods Hole and here on the theory

of winds and the current. This is a generalization of the older theory and has for the first time indicated why the western part of each ocean is the scene of such things as the Gulf stream and various types of currents, the Sea, a big heavy , and really shows promise of a theoretical understanding of the whole oceanic current system. It does not yet extend to detail however. Much of the difficulty in studying ocean currents is that you can't see them and when the ships move along with them it's very difficult to measure them. So instrumentation is a very important aspect. One of the earliest forms was the drift model and the comparison of the observed or calculated position of the ship. So work of that type is going on here. We have recently obtained from Woods Hole and are beginning to make accurate use of it a device which measures electric potentials in the water when the water moves through the earth of a magnetic field. And it appears to me that this device as it becomes more widely used will probably revolutionize our knowledge of ocean currents. The inshore currents I'm going to mention only very briefly as those that occur quite close to the beach. They are of great interest first of all to the geologist, the man who is interested in the beaches and are being studied by Dr. Shephard McGrue. I'm sure he'll have more to say about them. In addition there are some physical phenomena ~~which~~ that have been studied most intensely by biologists, Dr. Hubbs. If you ~~also~~ move along the beach and measure the temperature of the water, it is not uniform and there are very systematic differences in temperature, which are undoubtedly maintained by the currents and the tidal oscillations. And Dr. Hubbs has worked on that for the last 2 or 3 years. Another major item from the program of the institution is the study of certain waves . This began purely as technology during the war. It was necessary to forecast surfs for the amphibious operations and as a result a great deal of study was devoted to the of waves for periods from 6 to 20 seconds, which are impossible to ~~observe~~. It was found that the ~~math~~ drifting mathematical theory was a very useful guide and additional types were used to develop a system of forecasting. After the war it was realized that this particular arrangement period was a small segment of the whole section and the study of other cycle has been pushed. There was decidedly a long period there when we had the tides with periods from 6, 12, to 24 hours, and this has for many years been done from a field, and we have continued to give courses on the tides

E. Clark

I believe and also responsible/for our cooperation with the Coastal Geonetic Survey, maintaining a . The so-called tidal waves have nothing to do with destructive tidal waves which is not a tide at all but is caused by an earthquake and which we're , have a period from ten to fifteen minutes. And Dr. Shephard had an opportunity to study the and partly as a result of that theoretical work on the subject was undertaken with the rather disconcerting results that there never ought to be a destructive tidal wave. The earthquake or rather the earthquake should produce only a few inches of motion. Our only consolation there is that that's ~~maxx~~ true of most earthquakes. It is a rare earthquake that produces a destructive . Dr. Munk has developed a recording instrument that some of you have seen for measuring these long period low aptitude waves and is able to record the waves for these periods whose aptitudes are only a few centimeters. Next comes part of the section of the four minute period ^{apparently} which/has considerably higher aptitude, not much higher, but somewhat higher aptitudes than these others and is apparently connected with the, you've probably all heard that , element of quality of truth in that and as each wave brings some water into the shore the highest wave four minutes. We have the phenomenon that has been called surf-beating and is the same level as the four minute period. The originally the so-called swell by at least 35 seconds or so recorded we have more heavily from our friends in Berkeley and are using recording instruments that developed there during the war. In the analysis of the records we also have made use of instruments and are developing other instruments ourselves. A very considerable amount of theoretical work has been done on surface waves. Recently short period has come under study. Dr. Munk and Dr. Ewing are developing methods ~~of~~ for photographing the sea surface and determining something about the shapes, which is highly irregular and one of the great in the practical sense of the theoretical ones sea surface. The system which has been used for ships, talking about these too.

Eckart

liketo adopt and it is almost more of a measure of the wind than the shape of the sea surface. Dr. Ewing also has become very interested in ripples which are not gravity waves, they are portions of their capillary sea surface, and there is a possibility that these have very considerable importance in the theory of the interaction between the wind and the water. Through this work he has also come into contact with study the effect of surface and particularly

. For years of surface phenomena.

This list is probably incomplete and I'm sure I could find other things to mention in connection with physical oceanography. However I'm going to jump now to the program of the marine physical laboratory which was the study of underwater sound. There we have undertaken first the study of the of sound rather somewhat cooperative with Dr. Leonard of U.C.L.A. and one of the startling results sound

water. The fact that one particular ties in very directly with some work done a number of years ago .

Another really resulted in somewhat modifying our ideas about the physical properties of in a number of ways, but I won't go into detail. through The second major phase of the work is the transmission of sound/and the reflection of it from the bottom, which is the field in which D.r Ragan worked and particularly penetration interpret into the bottom is of great interest to geologists in that it is possible to ~~get~~ the echo in terms of the geological structures the bottom. One item that has a biological although it flavor/was discovered with apparatus, depth-finding apparatus, is a layer of the ocean that is about 1000 to 1500 feet deep below the surface in which large amounts of presumably animal life are found. depth daytime ~~depth~~ depth

and move to the surface at night. The principal work that has been done on this phenomenon recently has been developments of methods for determine what these animals are. Previously we had concentrated on and had merely succeeded in confusing ourselves, trying to determine the size of the animals with no great success. There is also here on

Eckart

the campus a quite large program called bathythermograph program. Bathythermograph was developed during the war at Woods Hole and was a method for ~~determining~~ obtaining a graph of the temperature as a function of depth in the upper layers of the ocean. And this was of considerable interest to the Navy and consequently _____ office and also the fleet have cooperated in obtaining a great number of observations of this sort and this Institution has undertaken for the _____ office to maintain those records to properly preserve them, to preserve all the records, _____ Pacific Ocean. A certain number of studies, oceanographic studies, have also been made based on these bathythermographs. Another development at the marine physical laboratory is what we have called _____. Typical of all geophysical phenomena is that you don't get a nice beautiful term when you _____ one phenomenon against another or against _____. We seem to get an irregular term. And in recent years it has been more and more _____ on the part of mathematicians, communication engineers and others in such irregular terms and one technique that has been used in studying them is _____, and Woods Hole has developed a rapid meaning

An alternative method is the so-called audible ~~auto~~^e correlation audible?

A great many of you are familiar with the idea of correlation and ~~auto~~-correlation means correlation with sound

. It's quite laborious to make calculations of this sort so an American calculator has been devised for making the work easier. In addition a certain amount of theoretical work has gone on and Dr. _____ has been largely responsible for this work. I believe that is a fairly adequate survey of the program in oceanography here at the Institution.

Iselin From what Dr. Eckart has said I'd like to add a word or two. ~~ifxxx~~ It seems to me that if we look at the other sciences today, _____ we get the feeling that meteorology ~~is~~ has been dragging its feet during the last 15 years. Together the circulation of the ~~topo~~ sphere and the hydrosphere constitute a huge and most complicated _____. In oceanography we can start with the assumption that most of our energy comes from the ~~atmosphere~~ ^{atmosphere} ~~atmosphere~~, but not all of it. And the ocean also draws some of its energy from heating and cooling and from the ~~evaporation~~ ^{evaporation} and precipitation

Iselin

. Now in turn the ocean reacts on the atmosphere and these currents are set up by winds and the currents are set up by changes in density occurring at the surface. These in turn effect half of these huge .

there are considerable gains to be made by properly physical oceanography and meteorology. Because of their superior facilities, especially for instrumental development, I think that it is up to the oceanographic laboratory to make a start in developing the fields of marine meteorology and that if this is done I think we can expect some most exciting results to come out of such a study during the next 10 or 15 years. I'd like to call next on Dr. Shephard, who will discuss research in submarine geology and geophysics.

Shephard Gentlemen. I'd like to start out with a little explanation and apology. The explanation is that my colleagues have beseeched me not to talk about submarine carriers for fear that they wouldn't get through in time for lunch. So I will try to keep away from that subject. The apology is that I've been such an infrequent visitor to La Jolla almost as bad as Dr. . I've had very little time with which to scribble a few notes about our program and with your kind permission I will try to read

that
It has been almost a century now since geologists first appreciated ~~and~~ most the progress of sedimentary rocks were deposited in the ocean. But unfortunately for science it is only begun during the last quarter of a century that geologists have ~~done~~ serious investigations on the environments in which these ~~strange~~ same sedimentary rocks must have been deposited. Deeply serious science has been the almost complete neglect ~~that~~ of the three quarters of the earth's surface, or 72% to be more exact, because ~~it happened that~~ of the fact that it happened to be covered by the oceans. Fascinating glimpses of the underwater realm came from the Challenger expedition 75 years ago, and a number of other oceanographic expeditions in the next 50 years added a greater amount of knowledge from which geologists made an attempt to construct a very fragmentary picture of marine conditions. Needless to say the picture was so bad, as Mr. Cox was saying last night, that almost all of the a few years ago must now ~~be~~ be disguised. For example you may have read in school as I did that vast areas of the ocean bottom are flat and

Shepard

and that sediments grow finer and finer

shore until only the finest sediments and shells are found
Actually
on the deep sea floor./ We find now that the sea bottom is at least as irregular as the land
may be seen by that I can't mention

and that coarse sediments, sand and even gravel are deposited at great depths. Discoveries
of this sort have been pretty upsetting to geologists. Many of the older men at first
refused to believe the facts, some of the younger ones too.

evidence until it finally became a little bit embarrassing not to believe that these things
actually existed. It has been a great struggle to establish submarine / ^{geology} as a

legitimate member of the oceanographic institution, certainly the fault of ~~the geologists~~
as
geologists ~~xxx~~ much as any of the kindred branches of science. If there weren't any geologists

who could show ~~you~~ the importance of fitting this
branch into the right institution. Dr. Revelle, I believe, is the first scientist who had
basic training to prepare for work of this kind. To show how little progress had been made
by the time of world war II it should be mentioned that Roger was the only full time member
of any oceanographic institution staff who had submarine

geology. The war produced a real change in the picture and finally because the navies
of the world, particularly our own navy, was shown forcibly that it was necessary to know
something about the ocean bottom and something about the shores and beaches

Reel VI

has now been augmented by large sums from the American Petroleum Institute
institutions, which have just been offered to the U. of C.

We do have a large group working under contracts of various sources and are gradually
emerging from their state of a foster child into a legitimate membership in the
oceanographic ~~fx~~ . During the past two years

joined in our work by and his able assistants in the formidable
research laboratory, by Douglas ~~Fin~~man who is working on the beach and nearshore problems
has
, by Jack who ~~ixx~~come to us to take charge of and build

Shepard

up our marine sediments laboratory of which you had a glimpse yesterday, Scripps field annex. I can't begin to express to you the important help which all of these people have had in developing our program. It's a little hard to estimate the percentage in increase of graduate students in geology since the war but the enrollment has grown from zero to 13. I wonder how we would figure that in the inverse third . We've been fortunate in keeping some of our best students at work here and expect to draw heavily on them for the API research program.

Since the program in marine geology at Scripps Institution and at the Naval Electronics Laboratory, who cooperate so splendidly with us in our work. Since it's equalled only by the combined program of Woods Hole and Columbia University and since there is essentially no other work in this branch anywhere in the western world, it is important that our program be international, oceanwide in its development. For the past 17 years we have worked almost exclusively in the area off the California coast, doing some work in the Gulf of California and the Hawaiian Islands. This is as it should be as it ~~is~~ would be a great mistake to spread around the world before finding out what is going on at your own doorstep and furthermore we have to ~~develop~~ ^{develop} the necessary techniques in this field to develop such techniques in your own home waters, less expense involved. It could be argued California a good deal

This might be true if there were other groups tackling the problem in the rest of the world but there are not nearly enough and we ~~definitely~~ ^{desperately} need more information from outside areas. fields

geology has been aptly demonstrated by Maurice Ewing whose discoveries during the cruises to the mid-Atlantic and across the Atlantic Ocean. I would now like to point to our own expedition conducted jointly with the Naval Electronics Laboratory last summer under the leadership of Dr. which carried us far into the Pacific and led to the discovery of submerged islands, and the intricacies of submarine topography of great mountain ranges, actually a ~~in the deep ocean~~ thousand miles in the deep ocean which was known previously only in bare outline. ^{These} Recent

Shepard

discoveries ~~through~~ throw important new light on our work in submarine geology and certainly help us to understand submarine ~~x~~ and these other pictures , off the California coast. Long which were obtained by comparison during the Swedish Deep-Sea Expedition more than 50 feet or more in length have led to discoveries which bear directly on some of our local problems. working from the ~~formifera~~ ^{foraminifera}

shallow-water organisms have come from the deep waters, that is they were actually found in the deep water of the Atlantic and other oceans and these layers are quite comparable to sand layers in the work which we discovered, somewhat to our amazement, /in this relatively deep trough in the basin off the Calif. coast

And ~~this~~ similarly the Pacific expedition last summer brought other coarse sediments from the deep waters of the Pacific. How can one properly evaluate of this sort without knowing whether they are purely local phenomena or purely local ~~formifera~~ ^{foraminifera}

characteristics pictures. While discussing the deep ocean phase of our work I'm going to mention some really exciting developments which have been coming in recently both from Dr. Ewing's work in the Atlantic and from our work conducted of this group by Dr. /in the Pacific and from the Swedish Deep-Sea Expedition. Geologists have speculated for a long time and have gone to no end of effort to see if they couldn't tell how thick the sediments were which over-lie the crust of the deep oceans. It has been generally assumed that there were several miles of sediment that covered this crystalizing basin. has been based

age of the ocean.

Now at last we have been given some data from geophysical measures

sea floor which indicates that for several miles are ~~thick~~ far ~~thick~~, too thick , the data from both the Atlantic and the Pacific suggests, well in the Atlantic probably doesn't reach more than 3000 feet and perhaps 2000 feet in the Pacific with definite indications that inversely no sedimentary mammal covering / large tracks of the sea bottom. Beneath this measurements show him ^{high speed} layers not very far ~~below~~ ^{below} the surface, six and one-half kilometers per second. It has been argued for many

Shepard

years by a group of geologist that there must be a/crust ~~of~~ zone of granite underneath the Atlantic and not under the Pacific, but actually now that we have some real measurements that doesn't show up agree with what I am saying, apparently doesn't show up under the Atlantic; there must be this same heavy under the Atlantic as under the Pacific. Since off the California coast, by giving certain approximations on the thickness of sediments that lie in these areas, a point of ~~great~~ ^{some} importance when you think that the basins may be very similar to the basins which existed in the Los Angeles and Ventura area and in which now we find large oil deposits. Here are early guesses, that there are a few thousand feet of sediment, has proven to be somewhat. The importance of finding the temperature sea floor, was impressed upon us by Dr. Jack ~~who~~ who is now director of the Jacksonville Physics Laboratory England. Working partly under his direction Mr. of our group has obtained results from last summer's mid-Pacific expedition which indicate that temperatures under the ocean are considerably higher than they are under the land, about 0.1 degrees. However it is estimated that is about the same as it is on the land. Now that could be important because a lot of people figure that theoretically there is a very much higher heat flow out of the ocean than from the

One of the chief excuses for a geologist undertaking oceanographic ~~work~~ investigations is to find out about the conditions under which the sedimentary rocks of the land were deposited. This phase of our program which particularly despite the collections and study of thousands of samples of recent sediments at Woods Hole and this Institution. It happens that most of the collecting areas both here and at the Atlantic have been environments which are not very representative of the environments in which we think sedimentary rocks were deposited. This is partly because so much of our work has been carried out along ~~open~~ ^{open} coasts and deep basins where sedimentary rocks we think were deposited in shallow water, shallow water

beaches, in and around deltas and in lagoons. Some of us have been realizing this shortcoming and as a result have worked to get a program under way

Shepard

that will test many of the other environments. This program now has been made possible by the American Petroleum Institute and the field will be conducted in the shallow waters Gulf Coast of the U.S. Recent work in that area by Dr. and myself has been greatly assisted by Mr. Cox, having provided us with an amphibious wonderful opportunity to fly for six days all along the Gulf Coast and get a birds-eye view of some of these areas which will be quite helpful.

marine sediments in the beaches in the area mostly by the geologists at the University of Louisiana and geologists of the oil companies serves to indicate that a great variety of sedimentary environments are represented here Rio Grande empties into the Gulf of Mexico Mississippi and finally to the relatively sand sand environment northwest Florida to the pure lime deposits of Southern Florida. The Gulf Coast is important also because it is an area of great storms, hurricanes that must have enormous influence on sedimentary deposits. The opportunity to study the effects of these storms is something that I look forward to particularly because nothing had been done before to determine where agent deposits were the result of storms. The coast of southern California approximately or un-approximately ~~un-approximately~~ to my point of view, has no live storms, or perhaps I should say never has had really live storms. Geological work is of primary importance and works hand-in-glove with the other branches of oceanography. Many of the mistaken ideas which geologists have had in the past have been the result of inadequate understandings of physics of the ocean. Waves and currents have been almost completely misinterpreted by many geologists. One of our best cooperative undertakings here at Scripps I think has been ~~xxxx~~ with the group in physical oceanography particularly Dr. Munk and Mr. Isaacs in finding out about the longshore currents and their relations to wave, and to winds, and to submarine topography. The two groups tackled the subject ^{somewhat} in/different ways originally and found that they had rather widely results. Now working together they have been able to assist each other

Shepard

in getting reasonably satisfactory explanations. along the coast

by a great deal of loss of life as the rip currents.

Many applications as well as life saving applications and we certainly intend to continue them and to delve more deeply into their secrets.

Relations between biology and ~~xxxx~~ submarine geological studies have proven particularly important in the qualifying work for which the group is known all over here at the Institution have been carried on. point our sea floor

which adds greatly to the other evidence of the mass movements of sediments on the slope is going on in all sorts of environments. API work

group have found characteristic which in turn will help to

show the environment of these ancient deposits which have more or less very well developed. The rate of sedimentation has been established partly by of ~~foraminifera~~ ^{foraminifera} study.

The climatic of the Atlantic has been interpreted by by studying along the lengths of these great which and others have obtained. During the war Dr. Johnson and I ~~xxxx~~ worked closely together in determining the famous , the snapping shrimp which caused a lot of confusement, particularly among our Woods Hole colleagues, but proved to be rather important in connection with submarine warfare. Because these little animals, they snap their fingers because submarine. However we found out .

studies that these are very much confined who rocky bottom of old . Dr. ZoBell/studied marine bacteria at many points contacted our submarine geology program .

future studies of the of sediments. ~~by~~ Dr. investigations in biochemistry close contact

effects of organisms on sediments and shores along the coast. Chemical of oceanography has significant effect on geological

investigations in numerous ways such as the scum rock,

Shepard

sea floor outside this area. I think we've just begun to find ways in which geological studies can be of importance to the armed services. Effects of different kinds of submarines currents, waves, and mines have been investigated only to a mild degree and as Roger pointed out to us recently this has become a problem of considerable urgency; something that we can certainly do. Studying shore in relation to landing operations has been very much slighted and should be given much more serious attention. The topography of the deep ocean now has the prospect of offering good means for navigation of submarines operating below the surface, and we should find out much more about the physio-graphic provinces of the sea floor and their geographic bounds. This is very much pointed out by the work last summer. ^{In} ^{it} /All of these undertakings/is important to attack the problem with a world-wide outlook and leave ~~out~~ behind the which may ~~;~~ have been too common in the past.

Iselin It seems to me that the work in submarine geology has been at Scripps and is of greatest scientific importance and that we can expect that this phase of oceanography will profit during the next 10 or 15 years. A combination of geo-physical studies of the ocean basins we have in this area an excellent chance of working out all equipment. This after all has been the primary goal of a good part (or) of all kinds. of the scientific work/from all times. I'd like to call next on Dr. Carl Hubbs who will tell us about research in marine biology.

Hubbs I feel very much flattered at being placed just spoke colleague that. At a rather recent seminar at this Institution when the visiting investigators were being introduced I was included. Scripps Institution, as Dr. Reville told you last night, was founded for biological research. From its organization, however, center oceanographic sense research in the broad sense. Its founder, William Ritter, could not conceive of organisms apart from their environment. The approach was ecological and the name was ^{early} ~~very~~ realized for they / ^{sought (?)} distribution of the physical and chemical properties of the sea and for explanations of the localized and regional variations in these properties. From this realization there stemmed some important contributions to the physical aspects of

Hulbert

oceanography. One of the more notable of which was the pioneering analysis by Dr. McEwen of the phenomenon of _____ of which we hear so much along this coast. I feel safe in saying that no biologist on the present staff would advocate or even tolerate the restoration of ~~this~~ Scripps institution into a seaside biological station even in the broad sense ~~in~~ which it functioned under Ritter. Nor is there any desire to build up within the Institution a separate unit to be devoted exclusively to biological research and graduate instruction. On the other hand there ~~was~~ would be strong opposition to the curtailment or elimination of biology, and our colleagues in chemistry, and physics and geology would join the biologists in opposing any such suggestion; there is none anticipated. Biologists would rather think of and work for an organization in which concerted attacks are made on the many complex problems which confront us in the sea which is our main laboratory.

administrative separation of the units that represent conventional disciplines but in the actual operation of the Institution in administration, instruction, and research the biologists favor and lean toward a considerable degree of decompartmentalizing. That is another way of saying that we aim toward a development of a science of oceanography in which staff members trained in several conventional fields of science may effectively collaborate in the study of the sea and all its characteristics giving regard to all its properties and constituents, organic and inorganic, and the transitional between them. Rather than separately cataloguing the various biological researches that are being conducted or that have been conducted or that are being contemplated, in the divisions dealing with biochemistry, with micro-biology, with plant physiology, with invertebrate zoology, _____, vertebrate zoology, I would devote the brief time that is available to mention some of the researches that have involved some sort of collaboration between certain of these biological divisions and between these divisions and the physical sciences and in so doing I would expend the theme that Dr. Shepard introduced because of a portion of his remarks of the cooperation of divisions. As a notable example of a thoroughly collaborating research I would first refer to a series of studies on the pigments of fishes in which Dr. _____ a professor here in the division of _____ biology very effectively worked with Dr. Fox of biochemistry. Quantitative analyses of the

Phillips

fishes subjected to various light conditions led to important conclusions regarding the physiology and environmental relations and evolutionary significance of pigmentation.

I have also encouraged some collaboration with Dr. Fox along similar lines the study of

of fishes and have joined with him in supervising work on the osmosis of fishes and in the physiology and biochemistry of _____ in fishes, as related to _____ definitely and light. Further cooperation along such lines is/anticipated. A series of other studies in biochemistry have been _____ in zoology, have included the relation between diet and pigment _____ . The diet of muscles and the tremendous turnover of organic matter _____ worms.

In the significant study _____ organic _____ of the sea, Dr. Fox profits from having associations with our special developments section, with marine life research, and with the divisions of marine botany, chemistry, and physical oceanography. His work on pigments for which he is particularly well known has had geological, chemical and botanical as well as _____ for contacts. There are many ways in which such integrated studies have contributed to our research output and will continue to do so. Micro-biology is a subject that naturally lends itself toward the advantages of team play. Integrations are many with geology, chemistry, biochemistry as well as the other biological sciences. The role of bacteria in ~~the role of~~ oil production has as you all know _____ of Dr. Revelle and his staff.

Micro-biological research is vitally concerned with the interpretation of organic cycles in the sea and in the bottom sediments. ^{There is evidence that} Virus bacterial and fungus diseases may have a major effect on the supply of food fishes _____ may be extensively subject to disease. For this reason a project in micro-biology has been added to our marine life research. The affect ~~of~~ on bacteria of the _____ of the deep sea are now being energetically studied and no doubt contribute to an understanding ~~the~~ bio-chemical processes and to the physical and biological conditions of the _____ regions. In many ways it will continue to be highly advantageous to have at Scripps such active programs in micro-biology. The work of the marine botany division under Dr. Sargent has been _____ correlated with that of the other divisions. From the quantitative

7/2/61

estimation chlorophyll and of photosynthesis
 in the sea there is a chemistry. The fundamental field in laboratory studies
 of marine correlate definitely with the studies by Dr. Rakestraw on the
 plant nutrient cycles. Dr. Walker has collaborated with Dr. Goldberg in chemistry
 a study dealing in ~~studying the~~ with the effects of concentrations on the phloringe determin-
 ations, and with the organic cycles of phosphorous. Considerable amount has been
 accomplished and a lot more is anticipated from analogies involving both theoretical
 and observational approaches of organic production in the sea, with regard to respiration,
 water nutrients
 processes. By its very nature such a project involves
 several of the fields of science. Dr. Johnson's division of marine invertebrates
 marine botany has been dealing primarily with has also been in
 close collaboration. Consider for example they have made contributions to the oceans
 in the discovery of the snapping shrimp ~~xxxxxxx~~ is
 a source in the major element in the marine and already referred to
 role leading / in the biological explanation of the scattering of
 water masses and their movements is contribution /to a better
 understanding of marine productivity through quantitative studies in .
 In the division of marine vertebrates much of the research involves inter-divisional
 cooperation. Collaboration with biochemistry has already been mentioned. Studies on the
 facts and controls of geographical distribution has added to extensive and intensive
 measurements of inshore temperatures, newly developed instruments
 as Dr. Eckart has mentioned. These studies have confirmed and have heartily specified
 the roles of meteorological and physiographic factors in determining shore temperatures.
 Differences as great as 11.4 degrees centigrade have been found on two sides of a point,
 on the same day.

The dominant role of temperature in the control of the distribution of organisms has been
 re-emphasized. With the aid of physical oceanographers and meteorologists an analysis has
 been made of historical data that indicated for long period of warm ocean and air temperatures

Hulbe

along the southern half of the California coast during the middle of the 19th century. By supplying critical material ascertained through areas and by running control temperature experiments we have been able to assist in detecting this method of estimating ocean temperatures through the analysis in mollusk shells. I have been able to spare a little time for continuation in studies in which the hydrographic history of the waves has been correlated in some detail with the present distribution of the fishes. Both collaborating with the institute, through collaboration with the designs, construction and operation of the new, relatively large and high ~~speed~~ speed, we are contributing to a survey of the invertebrate realm.

to which reference has already been made.

Our study of whales has opened the way for future researches of considerable interest involving apparently whale blubber. The whole

marine life research program has been from the start a collaboration program, in which almost all the divisions at Scripps have become actively and extensively ~~essentially~~ involved. In collaboration with ~~the~~ the State Division of Fish and Game, The Fish and Wild Life Service, and the Calif. Academy of Sciences. In this project several disciplines are being brought to bear on the fluctuating supply of marine ~~resources~~ (or) nation. resources which are so important to our/station. And particularly at present sardines. The biologist whose business it is to deal with the complexity of the marine processes seem particularly

This integration is made possible by the common forces of interest, the sea.

In turning our eyes ahead international situation not only a continuation and expansion of our present program but also some additions to the lines and projects of research. But above all we hope that in the continued projects for even further collaboration between the divisions.

One fundamental biological line that we would like to see further emphasized is as I have already stated the analysis of organic productivity in the sea in all its aspects.

Hubbs

One phase of the expansion already planned is a study of the food and nutrition of the sardine.

_____ has been made available by the marine research committee. In both the plant and invertebrate divisions expansion

needed in the research on living organisms, as well as the plankton ones.

Such forms of living forms as the kelp, _____ algae, _____ grasses, barnacles, _____ and various others.

food production could well be renewed and given greater emphasis in connection with these studies. Another line that needs re-emphasis and re-establishment in view of Dr.

research here is the field of physiological _____ ogy. _____ organisms live and

prosper in certain _____ or regions _____ in other beaches

or areas. This study by its nature will involve both the physical and the organic aspects

of oceanography. A new and promising line of inquiry _____ fishes is that of

sensory perception and response in marine organisms. This approach likewise involves

the physical sciences _____ precise modern instrumentation

and the field is wide open. With a larger and more _____ more critical

studies should be undertaken of the scattering layer. Further research is also called

for in the field of under~~xx~~ water sounds of animal origin. Biologists, I am particularly in this

case, are interested with others in a back~~x~~ ward extension of our research program.

The projection of oceanography into the past, further development of what might ^{be called} _____ oceanography.

Of outstanding promise in this connection is the procurement and operation at Scripps of

_____ sea temperatures

_____ analysis

_____ other organic remains

according to the methods developed by Harold C. _____. We should be in a most

excellent position to provide further texts for the accuracy and reliability and applications

of this method. Another possibility that I am trying to initiate through _____ that I am

trying to get from Chicago is the determination through the analysis of both oxygen and

carbon _____ on Indian _____ shells of sea temperatures that dated from periods

of the past. In this way we may be able to put ~~forth the method~~ a fourth dimension

_____ . I have already noticed that _____ mollusks are included

along the presently cool areas, indicating the prolonged positions of these cold spots

Subbia

and of prolonged conditions, meteorological conditions, that are responsible for these
cold areas.. There is a ~~strong~~^{crying} need for expanding these and other studies of the vast
conditions along our shore lines. And such expanded studies combining the physical,
chemical, ^{geological} and biological approaches should very well be carried on by an
augmented staff at Scripps. For the tertiary and the ~~pliocene~~^(sp) *pleistocene*

physiographic
and alternating
estimated/sequences

much more readily and precisely than are now known. Particularly ~~of~~ for the very important
~~pleistocene~~ periods should be studied by systematic geologists

and its ecology. The ocean floor as well as the shoreline
needs to ^{be} studied in this connection. Laboratory would be very
prominently involved in such work. oceanic conditions during

the latter part of the it would be very desirable in my opinion
to round out the picture by making inquiries into the problems involved in the occupation
of the coast by man. What were the conditions that attracted early man to the coast?

What was the climate? How did the sea furnish food? What affects ~~it~~ did the easy procurement
adequate of/food have on women's culture? ~~relating to~~ Toward the end of solving such
questions ~~relating to~~ ~~the~~ the essential

addition to Scripps staff of an anthropological group whose function it would be
to illucidate relations between the sea and early man. The same approach might
well be applied to the present time and the contribution to human ecology.

In my portion of marine vertebrates I already attempt in an ~~amateurish~~ ^{amateurish}
way the preliminary treatment of man past and present as being himself mammals.

As one of our cultural responsibilities, particularly the welfare of California, I feel
Scripps that ~~the~~ Institution should increase the contributions that it can well make toward a
greater and wiser utilization of our marine resources. The need for which need not be
elaborated ^{before} ~~for~~ this group. Toward this end consideration within our staff is being given
to a proposal that an institute on marine resources be established at the University of Calif.
with its main center on the La Jolla campus. There is some divergence of opinion as

Hubbs

to whether the proposed body should include the present marine life ~~XXXXX~~ research program and even as to whether it should be incorporated into the Scripps Institution or whether it should be maintained as an associated, collaborating but independent unit. Suggestions along these points will be appreciated by the administration of the Institution. In the expansion of the biological and other research at Scripps, we feel, I think I represent the _____ of the biologists, that we should restrict our growth to projects and fields that have a definite relation to the ocean for the strength of our diversity lies in our common focus. We should restrict our operations to those fields for which we are particularly well situated and equipped to cultivate thoroughly. Only in this way can we take full advantage of our elevation, of our sea-going equipment, particularly of our own immediate biotic environment which is an aggregation of scientists whose eyes look toward the sea. Rather than going into a dif/fuse campus it seems much wiser to expand our present program, to bring/^{to}the La Jolla campus projects, some perhaps as associated departments or externally supported laboratories, that would join with us in researches on the sea. To expand also our _____ into the past as I have just indicated. And to expand our operations to the north and to the south and to the open Pacific _____ and where we can go advantageously into the other oceans. Our horizon should be broad but it should remain the horizon of the sea. My presentation would be incomplete should I avoid/^{consideration of}how biology may be adapted to the national emergency. The biologists here are not happy with suggestions that the biological work here might be/^{greatly}curtailed or abandoned "should the situation worsen". _____ are to be anticipated, but we feel that biologists with an ecological outlook can contribute much to a nation in any degree of emergency, working in their own general field. We would plead for an opportunity of playing our part in our own field in researches of obvious or potential significance in the national defense. Our part of training young men for the present and future needs that biologists serve and our part in maintaining our broad heritage of scientific accomplishment. Toward this end some of us would like to see relationships established between Scripps Institution and the biological as well as the geophysical branch of the Office of Naval Research. And would like to see other contacts established that would further the contribution that biology at Scripps may make toward

the welfare of the University, the state, and the nation.

Jacobs I would like to point out very briefly that at Woods Hole we have been very much concerned in recent years as to how to keep marine biology alive and healthy, during a period when the physics and the geology of the ocean are developing very rapidly. You've done a much better job here ^{than} and we have and I hope that we can soon begin to catch up. I'd also like to point out one field of biology that in my mind is very important and ~~has~~ Dr. Cox has mentioned, namely biological engineering.

fishing industries throughout the world engineering problem, rather than scientific problems. And I think at times that some people care to consider them as engineering problems. The fishing industry has nothing comparable to an agriculture experiment

in this country nor any where else that I know, to try out new and promising techniques. A year ago I ~~thought~~ thought that in all probability our biggest in this field

found that they were still sticking to the conventional approaches in marine biology. I will next call on Dr. Revelle who will try to assemble all this together.

Scripps

Revelle I'm going to talk primarily this morning about the problems of research at ~~the~~ Institution. All of the problems of this Institution are inter-related, and inter-related to some extent in a rather important way, the ~~xxxxxxx~~ ^{solution} of one may aggravate another. The problems of our research program are first, that of attempting to maintain free research, by which we mean enabling individual scientists to follow his own star. Scientists of course are all in favor of this because this is the way they have the maximum amount of fun. The progress of science I think can be very clearly demonstrated really depends upon letting scientists do what they want to do and encouraging them to do the things that they are interested in. This is really a wonderful fact that the best science is done the way the scientists like to do it anyhow. The problems of maintaining free research here are fourfold. In the first place oceanography is a relatively small part of the ^{field of} total knowledge. The result is that our staff members

Reville

after they have come here and after they have started a problem in the study of the sea, they during the course of the years gradually become interested in problems that have no relation to the sea. And we then wonder what to do. It's obvious that for the best good of science as a whole, scientists here as elsewhere should do what they are best fitted to do which means usually ~~xxxxxxx~~ what they're most interested in. A staff member here working on a problem outside the ocean ~~xxxx~~ takes the place really of someone who might be working on an oceanographic problem. The ~~xxxx~~ department of _____ at the Carnegie Institution, an institution somewhat comparable to this one in size, they have solved the problem by giving up any intent _____ studying biology, nuclear physics, any darn thing they want to _____.

I feel myself that only a university is really wide enough in scope to allow completely free research. The university deals with/ [?] of knowledge, and for this reason I personally would like to see established here at La Jolla eventually perhaps within the next 20 years a University graduate school which really encompasses all of the fields of learning. This is a very _____ reason for doing this _____ perhaps tomorrow morning seems very important reasons other than the _____ problems of Scripps Institution, the fact might be done. The second _____ on free research here is/that we have here four expensive ships, sea going shps. These ships are very expensive to operate, they constitute a unique facility for scientific progress. We tend to feel that we need to use them to a maximum. We feel that we have a sense of responsibility to science as a whole, to see if we can get the most out of these ships. This means that we tend to limit ourselves to problems requiring the use of ships and we tend to use perhaps too large a fraction of our time taking off _____ at sea, and routinely working up the data obtained, rather than thinking about the meaning of our observations. I believe that this problem can in part be solved, by attracting a continuous flow of visitors to the Institution and by interesting science^{ists} throughout the country in the possibilities of work at sea, what can be done on our ships on ~~xxx~~ problems that they themselves think of, in other words expanding the scientific base of our operations, by encouraging their use by scientists outside the Institution, throughout the other campuses of the university, and throughout the country.

Revelle

on free research ~~taxxxxx~~ is the pressure to which we are subjected from the practical users of oceanographic information. This is an example of a self-contradictory problem because practical interest in oceanography is the principal basis for our support here at Scripps. I'd like to give you a few figures on our budget to emphasize this point. At the present time we have an annual budget of about \$1, 100, 000.00. Because of the present national emergency this budget in the near future may be increased to about \$2,000,000.00 per year. Of this amount some \$270,000 is what is known as the academic budget of the Institution. This comes to us from the University, from the State Legislature, and a small part from the Scripps endowment, for university work for teaching and completely free research. This budget supports the faculty on our staff and some 15 other people. It also pays for about one-tenth of our ship operations. Our total budget for our ship operations this year is about \$280,000; of this \$22,000 comes from the University of California for whatever use we may want to put it to, for the ships. We obtain, in addition to this \$270,000, some \$400,000 to the University for our Marine Life Research program. This is our name for what is known elsewhere as the United California Cooperative Sardine Research Program, in which the/States Fish and Wild Life Service, and the California Academy of Sciences are associated with the Scripps Institution. About half of this \$400,000 goes toward full-time operation of two of our four ships, the other \$200,000 goes very largely toward working on the data obtained. As a matter of fact we've recently tried to establish this program on a relatively broad basis with emphasis on development of new oceanographic methods, on different types of biological work as well as on the taking of routine physical and chemical/^{data}from the waters off the west coast of North America. We found however, that we were all further and further behind in the simple routine tabulation and computation of the data obtained from the ships. At the present time this \$400,000 has gone very largely toward ship operations and these routine tabulations have been very seriously curtailed, or curtailed at least to a certain extent in the research program. The practical ~~xxxxxxx~~ problem of sardine research is to be able to predict the size of the sardine catch in advance of the fishing season and tell the fishermen where the sardines will be during the fishing season. This is an extremely complex problem. It can be solved but certainly can't be solved in any short time.

Our staff the experimental and unorthodox work that they would like to do will contribute importantly and basically to this problem. But the support that we receive from the fishing industry tends to be channelized, as I pointed out, towards taking routine observations which can be used for statistical studies. I entertain a slight worry about the American Petroleum Institute project because of this same type of problem. Fourth, we are faced with an immediate problem that we hope will eventually disappear, that is the critical military situation of the United States. Many of us believe that at the present time we are faced with a struggle for survival, taxing every resource of the country, ~~including its entire scientific~~ and including the intellectual and moral resources of the entire scientific profession. Oceanography can play a considerable role in advancing the military strength of the United States. For example, let me sight 3 military problems: the problem of mine warfare, one of the most serious problems facing the country today because it jeopardizes to an extent not generally realized, our capability in maintaining overseas transport, particularly of doing something about enemy mining of European ports. This ~~xxx~~ in its oceanographic aspects, means that oceanographers must find out just about all there is to know about harbors and about inshore waters, about the character of the bottom, about how the bottom changes, about how the harbor flushes, that is the interchange of water from the harbor and the open sea, about the current in the harbors and the inshore waters, the waves, the organic growth on the bottom, the kinds of organisms there are in the water, the transparency of the water, nothing that you can think of that no oceanographic problem or oceanographic characteristic of inshore harbor waters which doesn't need to be more thoroughly known, if we are going to solve the problems of mine warfare. Secondly, the problem of amphibious operations. This is intimately related to the problem of mine warfare, because we may have to use beaches and all sorts of unlikely places to get our cargoes ~~xxxxx~~ across the boundaries between the land and the sea, or to ship them across the ocean. We really need to know about waves, surf, inshore waters on beaches. We need to know about the depth of water in the beach, the slope of the beach, how the slope of the beach changes from time to time; we need to know what the bearing qualities of beaches are so that we can get vehicles across them. The problem of beaches requires intense and elaborate study. Third, various problems of

submarine detection and attack. These are essentially, as far as oceanography is concerned, involve study of the means of transmitting energy through the sea, in other words communicating with the submarines. done largely

in World War II. When the submarine was submerged it was by using underwater sound.

Fortunately the submarines operate very largely on the surface, we didn't have to worry about the of the ocean, used radar to a considerable extent. But the present submarines and particularly future submarines can be expected to operate almost entirely submerged. So we need to know about/transmitting energy through the water. A very fine attack on this question, the one that's been developed very admirably by the

Institution, is the use of low-frequency sound, frequency below 1000 cycles and on down to very low frequencies indeed. It may be possible also to use other types of energy transmissions through the water submarine, but here again and for all these problems, mine warfare, amphibious operations, and undersea warfare, we need to do a great deal of work. This will inevitably divert many of our present staff from longer range research, will involve expansion of our staff, and diversion of young men, scientists who are now working on a great variety of problems into these relatively narrow military problems. Further we can expect that the progress of science will be quite considerably prohibited by the growth of applications of security, the inability of scientists to talk about what they are doing. So far in our contract research for the Navy Department we have had no problems of security. Virtually all of the work until the last few months has been unclassified and freely publishable, but this is liable not to be true in the future. The second general question involving our research program is how to improve the quality and how to increase the quantity of our research, It was pointed out by Dr. ZoBell and Dr. Redfield that last night that we are constantly aware of the notable unknown with which we are dealing and of the pitiful inadequacy of our effort. This problem of improving the quality and increasing the quantity also involves certain facets. In the first place how can we maintain a balanced program of oceanographic research? In this context and project research tends to throw our research effort out of balance. For example in the biological field alone the emphasis on the ecology of *Foraminifera* will tend to draw biologists into that field to the extent of studying the life history of vertebrates.

Reville

In general our contract research with the Navy Department tended greatly to expand physical oceanography and marine geology at the expense of marine biology. It has only been in the last few months that it has been realized that biology may play a far more important role in military problems, as not done in the past. On the other hand the expansion of military effort throughout the country may in the near future improve the balance of our research program. In general biology deals with life rather than death and therefore biological research in general is not as critical in time of war. There is not the tremendous pressure ~~xx~~ on biologists as there is on physicists and chemists particularly to go into military solving problems. We may therefore be able to obtain here a biological staff in the few years and our physics staff may be drawn away to major military development projects elsewhere. In any case it will certainly be very difficulty to expand. The second question of the quality of our research effort involves the size of the Scripps Institution. Obviously a scientific institution like man has an optimal size. As we all know there are no giants, not because God didn't want there to be, but because giants are ineffective

. Like wise the quality of scientific institutions. If we grow too large we lose the free interchange of ideas and the mutual stimulation of a small group working closely together. On the other hand by growing large we are reducing the isolation and provincialism from which a small institution ~~x~~ inevitably suffers. In general I feel that our present staff believes that this institution should ~~x~~ not get much larger except on a temporary basis because of the present military crisis, but rather we should improve the ~~xxxx~~ quality of our staff. How do we do this? Dr. ZoBell pointed out last night that we have 14 faculty members out of a ~~xxx~~ total employment of some 300 people. We sometimes feel that the Regents of the University think that the bottom is going to drop out of oceanography at any time.

The present mors of the scientific profession, however, suggest that it is very difficult to get first rate people, not impossible but very difficult unless you can give them faculty positions. The second question of our staff, of improving the quality of our staff, involves the question of what kind of science we want here. One answer to this question is that we want to increase our senior staff by

Bell VIII
Reul VIII

Reville

great scientists, great mature scientists, or very promising young scientists regardless of their special interests. nearly all aspects of science will eventually lead toward a solution of the problem of the sea. I myself feel that an increase in our senior biological staff is our present greatest need. Dr. Hubbs mentioned several types of problems that we're not attacking very effectively because we don't have enough people to do it. These include physiological ecologists, as to why critters in the ocean live where they do, and what are the physiological processes that determine their life pattern, population dynamics deals, unlike this previous subject, not with individuals but with masses of organisms as they affect the oceanic environment and as they are affected by it. We know virtually nothing about the life histories of , 95% of ~~ix~~ these animals live in the sea . A great many other biological fields which should be worked on, in which we need to know the answers if we're going to go ahead in a field in which we are concerned and which we do have active staff members. Science as you know seems inevitably to progress on a broad front. scientific ideas, new scientific ideas pop up usually in four or five different places almost simultaneously and I think reasonable interpretation of these factors that science can only advance a little bit in any one area beyond the ^{general} level of human knowledge. So we really need even to advance in the fields in which we are now working, filling in the gaps in biological research, fields which are forced to neglect because of lack of adequate staff. There is of course one other ~~thing~~ way to increase the quality of our work, that is to attract here a continuous flow of visitors ^{W.S.} of ~~various~~ scientists. We have always had the policy at this Institution of scientists coming here to work for short periods, as of course most University research departments ~~programs~~ have, particularly institutions of marine biological and seaside laboratories. But in recent years this has been much more difficult because of lack of laboratory space and particularly because of lack of adequate housing. La Jolla is a seaside resort now, housing is expensive and scarce and cottages that you see on the campus at the present time are occupied almost entirely by our staff members and are not available for visitors. Another question about the quality of our research involves the question of which is best, team research, present modern day research, or individual effort, the pattern of scientific work of the past fundamental discoveries

the present time is essentially communistic, that is the fishermen share and share alike in the catches of a boat. This very much limits the technological development of the fishing industry. We have the problems ~~of~~ in fishing and developing fisheries of marketing, how to get people to eat more fish, of processing, how to get the fish from the boats to the people who are hungry. In India, for example, where there is a great protein deficiency, where most people never get enough protein to _____, fish, one of the best and cheapest sources of protein are only eaten in coastal villages because they can't be preserved long enough to be transported into them. On the other hand the problems of the fisheries are only a small part of all the problems of the ocean. Here we have in this particular example a subject and a question _____ on the one hand and very much larger than oceanography/smaller on the other. We believe ~~exactly~~ the University of California as a whole can play the same role in the fisheries development as it has played for the last 75 years in agriculture. But this must be a University-wide effort by which the Scripps Institution plays perhaps the leading part but by no means the only part. And we have proposed informally to President Sproul that there be established a university-wide institute of marine resources, with headquarters on the La Jolla campus. This immediately raised lots of questions. For example, is this _____ function of the university to do this sort of thing? How does it affect the definition of the university as a place to educate young men? I started out a few minutes ago to give you our budget _____ and I just got through with the ~~amount~~ amount of money that the State of California contributes to this Institution. Of the remainder of the \$1, 100,000 most but not all is contributed at the present time by the Navy. The Bureau of Ships during the past year some \$160,000 ~~to~~ the Office of Naval Research about \$150,000, American Petroleum Institute some \$25,000, Rockefeller Foundation some \$7,000, Kelco Co. about \$4,000, the _____ about \$30,000. Just recently, just to show you how the budget changes, we've just recently entered upon a contract with the Air Forces, a new contract for expansion of our work, for some \$50,000 a year. The Office of Naval Research has already upped its budget to \$250,000 a year, The Bureau of Ships has increased its budget to \$300,000 a year, The American Petroleum Institute is increasing its support of certain aspects of our work to an annual rate of about \$125,000. We have tentatively agreed with the Office of Naval Research to attempt to

Revel

increase our work in the deep sea, keep one ship occupied full time exploring the deep sea biologically, meteorologically, and physically to the tune of about \$500,000 a year. So our budget with all of these projects which are very close to consummation, will be on the order of about \$2,000,000⁰a year in the very near future. I believe that that's a brief summary of our research program, and we'd appreciate discussion.

Jeelin

We have roughly an hour, during which I hope will be largely discussion of some of the points that have been raised this morning and in throwing the meeting open for discussion I hope each of you will talk about whatever it is that has been going through your mind by listening to these interesting and provocative speakers.

Lechart

There are two things that have not been said. One is the close inter-relation fully convinced myself that that relation must be very close, and general

one application that tends to be ignored. I think that any technologist who is not supported by pure science is bound to die. I recall a specific instance of that, a small glass company ~~laboratory~~ in Missouri which operated for years on the basis of formula handed down from father to son, and everything went well

began turning out purple glass and nearly went bankrupt. Much of the same thing happens periodically in the fishing industry. The pure science on the other hand seems to flourish even when it's devoid of technology, the best example of that is the sun, which I venture to say most ~~people~~ of you would have difficulty in thinking of two technologies that are related to the sun, but there are such technologies, navigation and the . More recently

. The other thing that I wanted to touch upon is the pressure from inside and outside to do something about our present national emergency. I think that these questions are perfectly legitimate and I frequently heard the remark from people who are not only but have been concerned with some of the Naval problems, why not expand the oceanographic institution to take care of it, let do it,

found myself emotionally opposed to this idea. One reason for it is that a typical example of the best that can be done by the scientific community for national defense is the radiation laboratory at MIP and its work with radar

Eckart

and one reason for that I believe has not been sufficiently emphasized. It involves together initially a very small group of people but highly competent people and the enthusiasm problems in that small group. allowed to spread into a larger group and resulted in the radar development. I don't believe that same initial emphasis would have been obtained had the work started at the existing institution, with a staff that had already gotten accustomed to each other and to the problems on which they were working. Just by adding more money to an existing outfit I don't believe we could get the same results as produced by the radiation laboratory at MIB. I believe that ^{if that} is going to be relevant ~~to~~ to our discussion here, we're going to have to consider the national emergency, along with our own wishes for the future.

Brink related to those Roger read a few minutes ago are significant.

Either one builds up certain institutions to ~~xxx~~ sizes which are incompatible with their evolutionary development and survival. Or ~~one~~ one has a preservation of institutions in larger number in many places. There are I find in Washington two lines of thought, there are those that feel that what we should do is establish large research establishments and to do this by, quite frankly, tearing down one which already exists and to destroy many university departments. There are others who feel that because of the probably long duration of the present emergency it is more important except in special cases for the development of ideas that ~~xxx~~ ^{have} already reached ^{they determine} stage. It is important to preserve organizations such as this at the size that/they can most effectively maintain, in order that there be a larger number of sources of ideas. Here are two points of view. I think they are in many instances irreconcilable, although as I say in some cases It is quite obvious that a laboratory for the development of ideas that have already been developed is essential for security. Personally I feel that we must keep ourselves in a flexible state of mind and also in a state of mind which resists hysteria. I think that there is a grave danger that we could, if we were never to do all things that all people think should be done in order to meet the present emergency; make ourselves unfitted for the emergency that might come in an acute phase some years later. I'm often reminded of the parable of the ~~fox~~ foolish who wondered whether or not/get caught without any oil in our

lamps in order that we can be

O'Brien

One thing

number of times of the
mentioned/application of these scientific results.

It seems to me that oceanography it depends on science and to a certain extent it is responsible for the development of certain sciences oceanography. But I wonder if one of the problems is not this a group that so long as you do not develop/in oceanography ~~xxxxxxx~~ whose interest is the application of the scientific results your scientists will always be under pressure to do that application. Now it is my feeling that there is a difference in viewpoint between the scientist and the engineer or the oceanographer as I am thinking of, which is very big. If the scientist becomes interested in the value of his work and its practical applications he probably will be deflected from lines of investigation that should be ~~xxxxxxxx~~ pursued. But if he tries to appraise each program for its utility or its value he will be deflected from being a good scientist. On the other hand the person interested in the application must appraise the result of each scientific program, try to piece together a picture or story of how it would be of value

engineering you are coming into a phase in which the economic aspect will be important. You mention the sardine. After you find the sardine and know something of its habits you will also have to think about, or someone will have to think about making the catch at reasonable cost. And I would suggest that there be thought given to the ~~xxxxxxxxxxxx~~ development of a group which

which makes application its primary the thinking is just as hard in the application, the criteria of success are even more rigid because the only measure of success in the practical ~~xxxxxxxx~~ application is the successful application and it's a very difficult problem to predict not only the physical performance but the cost involved in the use of . I think you'd all have this trouble as long as scientists^s are the only group responsible for the development of certain sciences which are no longer of interest to the physicist and the chemist, include mechanics and many others. And two-third of our engineering

O'Brien

be

faculty are essentially scientists and not engineers and that's as it should, as they are not concerned about the utility of the work they do. And then there's another group in engineering which is concerned with, and has a professional view, the application of these results. I think that might be a solution to some of the problems that have been mentioned and which are worried about at the moment by the scientists.

Maxfield In view of the fact that Dr. Revelle took a look at me when he indicated how scientists get together and work best, I'd like to get in just one thought: that where we are dealing with pure science, the attempt to find out more about the universe we live in; the type of motivation that Dr. Revelle indicated, that group effort should be spontaneous group effort, and not pushed by superior organization on top is completely correct. When, however you come to the stage of making a definite application of that for practical utilization my experience indicates that the kind of organization which is unsuited to the pure research pays larger dividends. In other words there you have to plan the groups to ~~ix~~ attack certain problems, you're not attacking a new front of science, you're trying to something already in the warehouse of science and apply to a particular problem, and there organization steps in. You may call it applied science, you may call it engineering but I think that you should very definitely keep that type of organization out of the pure science but that you should count on its appearing in the application. And I think a ~~xxxx~~ lot of mistakes ~~ix~~ are being made and a lot of fear is being generated is the attempt for some people to say that since organization has worked in the field of technology and engineering, let's apply it to pure science. And I don't think it will work there anything like the degree that it has worked in the field of technology.

Joelin I find myself very sympathetic with what both Dr. O'Brien and Dr. Maxfield have just said. Looking back at my own career I have been to oceanography for the last ten years and have organization.

suggest that we have a 10 minute recess

Revelle

I would simply like to comment briefly on what Dr. O'Brien said. I feel that there is a very real analogy between engineering and oceanography, and that their , unlike other sciences, dealing with the real world. Oceanography deals with something that actually exists, namely the ocean, whereas such things as physics and chemistry deal essentially with what is inside people's heads. Physics and chemistry for that reason are broadly applicable to problems of the real world. We can use the methods and the ~~skill~~ ability of physicists to attach problems with what exists but as a basic science they don't conform actually to what does exist. Oceanography on the other hand seems to me to be a very logical division of science dealing with a piece of the external world, requires the application of all kinds of scientific disciplines working in a more closely coordinated fashion, which is also true of engineering. You can apply almost any engineering problem, physics and chemistry, biology and many of the other subdivisions of modern science, have been broken down. So that in that way there is a real between oceanography and engineering. The traditional difference is that oceanographers like to think of themselves as working on problems which they themselves have dreamed up; whereas engineers very largely have to work on problems that somebody else has formulated.

Jselin I would like next to call on Dr. Chapman, hoping that he will have new thoughts on the general subject of the responsibility of oceanography in the questions involving world fisheries.

Chapman I think that I should like to make my comments not as ~~member~~ a representative of the Department of State, nor as a biologist, but more as a representative of the fishing industry, in California particularly. We have an utmost interest in practically everything that is going on at Scripps because we are harvesters of ~~the~~ one of the major cash crops that comes from the ocean, affected by the ocean than most other technologies, ~~most~~ other industries. We have to look at the program of research at Scripps largely from our standpoint in terms of our cost of production. To emphasize that, to point out, I might say that in November of this year there came to us a very expanded production of tuna, during the last year a up inventories in all warehouses and canneries. The result of that has been actually the major factor in the tie up of the fleet the last two months ~~or~~ or better. It was found that by cutting the price of tuna by a \$1.50 a case, less

Chapman

than a nickel a can, the tuna pulled out of the warehouses very freely. The big surplus had now been dissipated. But unfortunately cutting the price of tuna by \$1.50 a case came very close to taking all the profit out of the canning end of the business and that price could not be sustained indefinitely, present knowledge. The price has gone up again and the flow of tuna out of warehouses has slowed down. I wish to point out how that applies to the research program here. We simply must get our cost of production down if we are to get the vast/^{food}productive potential of the ocean to the consumer's table. The

is just cost ~~xx~~ if you can get the food out of the ocean to the consumer's table ~~xxx~~ at a price he can afford to pay, he will buy the food and use it. Otherwise it will remain in the ocean. Now as I have listened to what has gone on here in the discussion of the program at Scripps, it will probably surprise you to find that I was more interested in the physical oceanography program and in the geology and physics program of research than I was in the biological program. We have a very intense interest in the programs which are going forward in those two disciplines and most of the theoretical and applied phases. The production of fish out of southern California are for the most part pelagic fish~~xxxx~~ or nearly entirely pelagic fish~~xxxx~~, whose abundance, whose migrations, whose ~~xxxx~~ every aspect of ~~xx~~ life is closely correlated with the movements of the ocean currents, whether that be through the nutrients, through the affect of temperature or whatever, they are exclusively tied in with the climate of the ocean. We have to know a great deal more about that climate, about the movements of the ocean currents, in order to lower our cost of production. I point out that a tuna clipper leaving San Diego may spend as much as three months at sea during which he may not be fishing more than a week or ten days to get his full load. The remainder of the time they have spent cruising, in locating fish that will bite and getting the bait and so forth. These vessels, as your research vessels, cost/\$100,000 in the neighborhood of a year to operate whether you get any fish or not and the more days spent in productive fishing and the less days spent looking for fish will lower the cost of production. We have a need from the physical oceanographers for an application of known oceanographical methods to the present problems that we have. That is the thing that has occupied this discussion for the last night and day, the need for the theoretical work, the best work, and also the applied work. We must have ^{the} ~~a~~ strong ^{self} interest in theoretical work because that leads us to new methods

and new information. But we cannot dwell on that exclusively. We must have application of known oceanographic methods, ~~For instance~~ to our present problems. For instance we wish to have a very close understanding of the ocean currents between here and the Galapagos Islands in particular. It is a tremendous stretch of ocean and we wish to know not only the general pattern but we wish to know the current pattern quite specifically in detail because the fish are to be found where there are inter-spaces, where there is up-dwelling, where there is vertical circulation. We wish to know where that vertical circulation is. If you can even aid us to better our guesses, even by 10 or 15 per cent as to where these areas of vertical circulation occur, it will be of material, factual interest to us. We need to have a quite thorough survey of the bottom contours, and the detailed map that Dr. Shepard was talking about between here and the Galapagos Island because we know just by imperial correlation that the occurrence of fish is related to irregularities, even though those irregularities are far from the surface. The more we know about those irregularities, the more we think we will be able to cut down cruising time. A field that has not been mentioned here in our discussion formerly is the need for theoretical fisheries work. Nearly all of our fisheries research work now everywhere is addressed to practical problems. We need to have someplace, an organization or individuals who are able to spend their time on theoretical problems that fisheries bring up. As an example, I speak of the problems of population dynamics which is the key that is the basis of all of our fisheries work and our knowledge of fishery population dynamics is moving ahead as rapidly as any other field of population dynamics but it requires someplace where some people can just sit down as research scientists and not as engineers, as we defined engineers last evening, to inquire into these problems of population dynamics. More particularly we are interested in the larger field of the entire biological economy of the ocean, because we operate on only one piece of the biological economy. Ordinarily we harvest the top of the food chain, the remainder of the food chain and all its parts is of the utmost interest to us, not of sufficient practical interest that we can put money into it ourselves, but it is of considerable basic interest to us. I'll leave the research program there if I may and turn ~~over~~ a little bit to the educational program which we discussed last evening. I am very much interested in that having been associated with the School of Fisheries at the University of Washington for a time. I should

Chapman

like to mention that in the northwest we have a considerable educational program devoted to fisheries. The total research funds put into fisheries up in the northwest I think ^{a little} approximates or perhaps/exceeds the total amount of money which is put into oceanographical research here at Scripps. We have an extensive educational program in connection with that. We have had to train quite broadly and our training has been mainly with respect to the needs of the salmon industry. We have in the northwest now in the neighborhood of, somewhere between 200 and 225 research biologists working on the problems of salmon biology and population dynamics in salmon. The fishery research people that are coming down into this area are more and more the products of our training up there and it is not an adequate training for the fishery problems that emanate from or center upon the San Diego or southern California area. We are interested more in the inshore and fresh water problems there than is the case here. I think there is an opportunity at Scripps for some expansion in fisheries training down here. I think also that there should be some means worked out for the easier exchange of graduate students between Scripps and the School of Fisheries so that some students at least can be trained in both regimes. We spoke last night of the lack of desire here perhaps for training persons at the Master's level. We have much the same feeling up there. I'm not at all sure but that we might work to the point of training at the Master's level in one Institution and moving to the other Institution ~~for~~ for the PhD. level of training. At least there is room for the exchange of students on the graduate level between the two organizations, which would much benefit I believe the whole coast and it certainly would benefit the fisheries research program along the coast. I would like to pass on to ^{here} organizational policy at Scripps as it looks from our standpoint. We've been talking/about how much growth there should be, whether the growth at Scripps should be somewhat limited, or whether it should be expanded. I think that/^{actually}that argument is almost exclusively academic; Scripps is ~~growing~~ going to grow. And the problem is not whether or not Scripps is going to grow in actual size but how Scripps is going to be organized to preserve the freedom of investigation of the individual researcher and also accommodate these new, large, what we call oceanographical engineering projects. That is the chief thing I think to worry about, because there is no question whatsoever in my mind that Scripps is going to continue to grow. Scripps is essentially a service organization for the State which supports it, and as the

problems, such as they have, with respect to the ocean grows, there is going to be more and more demand for the growth of the organization to take on these new problems. I may say it while people here have a little psychological reaction to further growth. I think basically what everyone out here is doing is to stimulate growth. Because everyone wants to get in to find out more about this notable unknown, that we work on, and the force of everybody wishing to expand their operations is going to expand the whole Institution. I might say that the fishing industry of California is well able to support Scripps and has done so in the past. Roger mentioned this \$400,000 item for the marine life research program that was stimulated by the fishing industry, and it was until the new armed service program, developed, the largest single item of funds that Scripps had. The industry is quite willing to lend that political support which it essentially was, to get the money from the State Legislature, as long as they can see that there is some good ~~that~~ ^{to} ~~comex~~ from either short term or long term. I might say that we are similarly able to influence Federal appropriations to Scripps benefit. The appropriation now being obtained for the tuna ~~fixing~~ ^{commission} work will I'm sure augment the Scripps resources to some extent before the work of that commission is far advanced. A field which has not been developed here at all on fisheries is contract work with the industry. I might say that the School of Fisheries that have ~~xxxxxx~~ ^{begun} the Alaskan ^a ~~xxxxxx~~ salmon industry provides ~~the~~ fund now of about \$250,000 a year exclusively for the narrow problem of studying the biology of Alaskan salmon. The work is going ahead quite satisfactorily both from the standpoint of the University and of the industry. I might mention one other type of aid that the industry can give to Scripps and to all of the organization work in association with Scripps. We have a large fleet working out here, something over 200 vessels, more than 100 million dollars worth of vessels working continuously in the area between here and Alaska and those vessels are going back and forth day in and day out and provide certainly a facility on which some of the survey work and perhaps a good deal of the detailed work emanating from Scripps can be aided anyway. Certainly individual members of the fleet will be quite cooperative in taking out people and even to disturbing their ordinary line of work, to a slight extent anyway, to accommodate research people. I think it is a very large facility which has not been used to amount to anything at all. Most of the funds at Scripps, or a large share of them, have been put into

Chapman

vessel operation. There is a much greater vessel operation going on and which could be utilized free of cost to the Institution. Just in closing I should like to mention the proper position of fishing problems in Scripps program. I think that no Institution, no educational Institution, thrives for along period of time unless it is providing services for the community in which it exists and which supports it. The fishing industry ~~is~~ ^{has} a major part in the economy of San Diego; it brought about 54 million ~~xxx~~ dollars in cash into San Diego last year which is a considerable item ~~xxxxx~~ of the San Diego economy. It is growing and will continue to grow quite rapidly I believe. It is, I think, as I looked over the program and talks last night and today, saw a very considerable dependence at Scripps upon work from ~~and~~ money from the armed services and also training for the armed services. I think that depends a good deal on the state of emergency that exists. When there is no state of emergency the Congress is a little reluctant about such projects. When there is a state of emergency those funds flow freely. Whether the Institution should build on a continued state of emergency, and base its future program on a state of emergency I don't know. As a representative of ~~xxxxxx~~ the Department of State I'd like to say that that's a way to do but I'm not sure. But anyway I think that if the organization at Scripps Institution does rely on being of service to the local industries it will have a firmer foundation than if they rely exclusively on the support of the armed services.

Iselin For one coming from the East this has been a rather interesting talk. We think of our fishing industry as being important in New England. But nowhere in the Eastern universities that I know of is there any such group working on the fisheries problems, a group of any such size as Dr. Chapman has indicated exists in the Northwest. I for one would like to hear more about such matters and therefore I'm going to call on Dr. Shaeffer.

Schaeffer I am very willing to add to what Dr. Chapman has said and as far as the Northwest is concerned, I've been gone from there for so long that I have no detailed knowledge of just what is transpiring there. I will pass that over and perhaps let Dr. DeLacy take care of the on the current operations in the Northwest. I would like to mention three points, this morning's discussion. First is this matter of the practical

Schaeffer

research and the theoretical research. Fisheries' problems, in general, considering our lack of knowledge of the ocean in many of its aspects combine both the problems of the application of present knowledge and the advancement of knowledge into unknown fields. The thing that unifies the two are the necessity of getting the information with regard to the specific fisheries or we might say specific areas of the sea. In some instances it involves application of well-^{developed} / techniques, application of ~~xx~~ well-developed kinds of knowledge. In other cases it demands investigations into totally new fields and perhaps even the development of new disciplines. I think that's admirably exemplified by the Marine Life Research Program being conducted by Scripps Institution in cooperation with the other agencies interested in the sardine. It's one reason the sardine people have so many conferences I believe. That question of deciding how much effort needs to be put into the engineering sort of thing and how much needs to be put into the pure research in turn. The thing is however, in the case of pure research aspects they need to have some direction also to find out what needs to be found out for an ^{ultimate} ~~xxx~~ practical end. That is a problem for scientific administrators I suppose to determine how much freedom or lack of freedom individual scientists have to have to find out what needs to be found out and still at the same time to be working in those fields which are required to be worked in for the development of ~~xxxxxx~~ specific fishes. The second point I wish to mention is the point ^{on which} that Dr. Chapman spoke to you briefly, that fisheries' problems are not entirely biological problems, in fact problems of fisheries like the sardine fishery and the tuna fishery are not even essentially biological as biology is ordinarily thought of. They are more likely to be problems of the dynamics of the ocean in its larger sense, that is the physical and chemical inter-change in the ocean and the and the biological inter-change as being part of this larger oceanic circulation. There is a circulation of life in the ocean along with a circulation of matter and the dynamics of that situation are the center of interest of fishing research in its broadest sense.

The third thing that I would like to bring up is the matter that the tuna fisheries in particular, which is the most valuable fishery in the Pacific Ocean at the present time, is truly a high seas fishery, and our problems are those of the ocean far distant from shore. Oceanographic institutions, including Scripps, have in the past and at present are largely confining their work to the fringe of the sea. The number of oceanographical stations that

Schaefer

are taken and the theoretical work that is done and so on is in many instances confined to these, what would you call them, boundary problems. I believe the Gulf Stream and the exist partly because of the boundary. The tuna fisheries are expanding farther and farther off shore, and in some cases, as in the case of the North Pacific Albacore Fishery, they are conducted a thousand miles from the nearest land. They are truly off-shore fisheries and the fishery research of the future is going to demand a truly high seas oceanography. That is the direction we would like to see oceanography expand in from the standpoint of the tuna resources.

Jaelin I can agree very much with what has just been said. For many years now at Woods Hole we have been trying to study the North Atlantic Ocean as a whole rather than a part of it. We've got an advantage in that we've got a smaller ocean. ~~It's~~ It's still too big. But nevertheless I feel very strongly that until we can understand at least one ocean as a whole we will not be able to deal intelligently with many of these problems. We have still ten or fifteen minutes and to round ~~up~~ out this very interesting discussion I would like to call on Dr. DeLacy.

De Lacy Well, I wouldn't describe the organization and of the fisheries in the in detail Northwest/without invitation but since you've asked for further comments there in order to subject, I might mention briefly the work that is covered by some of the outfits. There are quite a few of them and in fact sometimes you think there are too many because sometimes when you hire a new secretary it probably takes about a month to know which one you're talking about when you mention so and so and the mail men are continually getting the mail deliveries mixed up and that sort of thing. The one that Dr. Chapman referred to as concerned with the Alaskan salmon is known ~~as~~ ^{as} the fishery research institute. Dr. W. F. Townsend . It started as a rather limited investigation of Alaska salmon and spread on to an entire new territory essentially , on into Central Alaska including Crystal Bay. The International Fishery Commission is another one of the outfits, the halibut study, and various members of the group have been associated with that. And readily appreciate the relationship with the fisheries through many of the oceanographic problems that have been posed and discussed here before this group. And Dr. Chapman is well familiar with that operation. He and I were at one time connected

with the field work

The Fish and Wild Life Service is represented there as well as in this section and all other coastal areas of the country. organization fishery building itself, the Fish and Wild Life Service has some representatives.

The School of Fisheries itself consists of a group of professors which vary from time to time in number and the percentage of time they devote to it, some of them working part time on their projects. But I can certainly agree with Dr. Chapman's comment of ~~for~~ the necessity for additional fisheries training at other institutions and preferably would be a great advantage. We have one end of our bulletin board at time, present time that is practically covered with notices, letters, and what not from different institutions anxious to hire men trained in fisheries work, and many of those notices just stay there week after week with very little response. I think that a supplementary training in this area would be most advantageous and there would be no shortage of students. In case some arrangements would be made to transfer students back and forth, it would be mutually beneficial. I don't like to put myself in the position of saying what size Scripps can or should grow to. Adding all these things will naturally increase its activities, and some of the old members thought perhaps their group is large enough. It's, as it has been repeated many times, however a very big ocean, perhaps the staff themselves will have to decide how much of it can be done at one place efficiently, and then maybe other stations eventually will come. A suggestion was made yesterday that numerous small stations might be better than one large station raises some doubts in my mind however. I think that that will aggravate a problem of committee meetings and get-togethers and inter-departmental coordination to a greater extent than exists today and I certainly favor the sizable unit that at least doesn't get to the proportions of Washington D. C.

Jacobs We still have a few minutes and I find that Dr. Atkins who is here representing the Office of Naval Research is going to have to leave right after lunch, and I wonder if he has a few words that he would like to say to us.

Atkins Dr. Chapman made one comment to which I feel I should reply. He mentioned something

Atkins

about, not necessarily the insecurity but the inadvisability of this institution of being dependent upon military support and at the termination of the ~~xxx~~ emergency there would be less funds available. I would like to point out that the Office of Naval Research which I represent was organized just after the end of hostilities, and our fear these days that with the emergency there would be less funds for research. I think it is in the opposite direction from what he said. And the Office of Naval Research recently has made plans to do what it can towards the long term research. For example the basic research program at this Institution has just been contracted for work for 3 years in the future. That is that's not a statement of intent but that's an actual research contract paid for until the spring of 1954. So that at least for the immediate future the research program should be as certain as anything can be in these times.

I would say that that's very comforting to hear.

I think we have come to the end of our time.

lunch.

Monday Evening

having spoke this afternoon I presume this is a way to keep me quiet as chairman. I find that having asked me to raise certain areas of disagreement which he would discuss. He has listed the disagreements and then walked out leaving me holding the bag. Rather than get into any discussion of disagreements I think I'll ask Dr. Fox, who I believe has something on his mind. I assume that what we are to do tonight and what will be continued tomorrow morning is a frank and free discussion of the issues which you heard presented yesterday and today. This I understand is research.

Fox I would be curious had I had an opportunity to speak 9 hours ago

higher and rather than that the opportunity to speak was deferred until now. I think it will be at least to slightly better advantage within the of my lack of ability to talk in public. I heard a lot of words this morning which were very fine and noble words, and I enjoy hearing them usually but the fact that they were used in the wrong combination, the wrong sequence was what was disturbing. Rather like Henry Dane's children in the Turn of the ; the poor innocents had learned some words which they were using^t which was pretty disastrous. Something ~~ik~~ like . You know what can arise from that if you're not very . So the words that I heard, and they're noble fine words, were pure applied science; the physical versus the biological channels of investigation. Fisheries, engineering, service institutions, particularly, and so on. The key note of oceanography is integration and I'm sure no one is more aware of this than someone who has to occupy within an Institution of Oceanography the position of marine biochemist and the demands made upon it. Were I not able to depend/heavily on my friends in a diversity of departments my scientific and professional career would collapse at once. This does not except any one of the divisions. I shall not burden you with a long story of that , but perhaps I can point to one or two ~~problems~~ problems that will sufficiently point up what I mean. If we are ~~studying~~ studying the sample sediments from the deep ocean , which are markers of ancient biochemical history, I really mean\$ ancient, going back tens or hundreds of thousands of years. It's a matter of extreme importance to me to be able to talk intelligently and understandingly with my friends in the division of submarine geology. I couldn't get along without Fran Shepard and his colleagues

Hox

in some of the things that I have to think about and have to do. I certainly couldn't get along without frequent intercourse with my people, my friends in the marine microbiology division, and similarly with the chemistry and biological divisions and certainly the physical division as well. For example, with respect to the surface of the sea and the phenomena which is applied to the surface. It is a very different set up than is found in the interior of the sea. The of the internal parts of the sea is no less necessary for this kind of communication. The field which I happen to be studying is that which is organic matter which is present in countless tons over the whole ocean, certainly the fragments weighing as much or more in their uncombined, that is their disorganized state, than all the organized protoplasm. This situation is not easily and nature very quickly solves it because the have to start eating each other until it is, and that is what began this complex picture. I think that what is a breakdown of . We can use these words and think we know what we're discussing but I have had a hard time and have been trying very hard to realize what the other ~~friend~~ fellow is talking about. The other evening I was in a group down in a town, a civic group, there were four of us there who had , talking to a man who had graduated from Cal. Tech. in physics and had been a scholar, and in a half hour we had failed to achieve what I thought was good communication. He didn't know what we were talking about and we didn't know what he was trying to get across. This is a very distressing business; we tried hard. After this morning's session I talked to some of my friends new and old here and got some interesting results from that. But we've still got far to go if we're going to talk about what oceanography consists of or in our minds should consist of. That is to say a study of natural phenomena with all of the tools at our command and with a steady advance along all fronts. Therefore we cannot have type compartments, we cannot have a series of separated disciplines ~~within~~ within any department of the earth's sciences or even any set department of the biological sciences. Perhaps this is somewhat reminiscent of the young lady, a very sweet young lady in college in her freshman year who was having trouble with her science. My ~~friend~~ colleagues have heard me tell stories like this before and they will bear with me if I repeat, this one. So she thought the best thing to do before this quiz came up was to go and pick out the most brilliant young student, student

Joy

instructor, and certainly the handsomest one, and spend an evening and see if she couldn't get some understanding of this. So this she did. She spent a full evening with the young man and at the end of the evening said this has been a most instructive evening and I'm sure I've profited immensely by it Mr. Revelle but I want to ask a question. These things that you've been telling me sound very plausible, they sound like things that really happened; I thought we were just talking about physics. That is something that we really need, ~~having~~ someone to come along with us and help us translate what we mean when we talk about some of things we're going to talk about. I cannot ~~separate~~ separate pure and applied science in the particular field I'm in if I'm going to be a scientist. I hope that what is being done in my laboratory under the help of the _____ and Rockefeller Foundation will prove useful as soon as possible to my friends working ~~x~~ in the American Petroleum Institute program and to my friends working in the fisheries program, and the sooner the better. And if they would consult with me afterwards, the more the better. But it doesn't mean that I'm ~~suddenly~~ suddenly going to switch and become a technician, I have my students do that. Perhaps if we go far enough we will come up with good semantics so that we'll understand what we mean when we're talking about an integrated field of science. I can't help feeling that we haven't gone very far with this yet and we find ourselves somewhat perhaps in the position of a man about whom I shall tell a story and after that I'll sit down and let someone else talk. There was a fine diplomat who was going to talk at a luncheon but unfortunately he didn't feel prepared because he said he didn't know the language. But they said that's quite all right you speak in your own language, there'll be an interpreter there. So before the luncheon took place one of the men saw the chairman and said now after this talk you pick on Stevenson because he will translate; he's a good man, he knows Polish. So the chairman at the end of the discussion which was ~~x~~ all in Polish, said now we've got a man here, we haven't been able to hear our present address in English, but that's quite all right his words are going to ^{be} translated by Mr. Stevens here. Mr. Stevens hadn't come but there was an unfortunate named Stevens sitting at the same table. There was a long prolonged silence. He finally thought he'd better do something as they pointed at him. So he got up and said well, Mr. _____ ski, said that our country is very lovely, that he's thrilled by our fine agricultural development and our canals, our

Fox

engineering, that our ladies are lovely, that our food is superb and that he looks forward to an ever increasing friendship between our two countries. And he sat down, upon which Mr. _____ ski turned to his friend and said, "a most superb translation."

Bronks I don't know

translate what you have

said or not. I think that you and I agree very much. I strongly feel that one of the primary necessities to have the ability for the sort of communication of which you speak is the broader training of individuals. I have a feeling that the thing which must go through ~~the~~ ^a single cerebral cortex if it is to be largely understood, and I have never been able to understand how one can by organization achieve the synthesis of which we speak, although we must have groups of individuals in order to accomplish the specialized activities which are necessary for the furtherance of scientific investigation. I assume that it would be appropriate to ask if there is anyone who wildly disagrees with Dr. Fox's thesis, or is there are any who would modify this before we go on to hear Roger explain what is the basis of the _____ within the Scripps Institution. If anyone disagrees with Dr. Fox's plea that there should be a better basis for understanding, As regards the differentiation between pure and applied research I might say that I was once asked this question when I was speaking at a meeting of the National Assoc. of Manufacturers. They are a very wealthy organization, I might add, or an organization ~~of very wealthy~~ ~~representative of an institution~~ which is representative of a very wealthy institution. So perhaps this is one of the reasons why I replied as I did. But I've never been able to think of a better distinction between pure and applied research which I gave on that morning on the wave of inspiration that came to me looking at George Burke and Gifford Upjohn and all the rest of these plutocrats. _____ fundamental basic research was that which was extremely difficult to get any financial support. _____ in hope evening, I passed the hat for the National Research Council, that I would get a \$500,000 fund to give out in support of basic research in chemistry and biology. I have still to receive the first 50¢ I might add. I should like to start with your discussion of the issues which confront your Institution, so that those of us who are not members of the Institution can tell you what to do about it.

Reville Actually this is just a collection of topics that I thought might focus the discussion

Revelle

a little. I think that these are questions which have arisen out of the discussions at the conference to date. I'm not at all sure that these are the right questions or the only questions. I'm quite glad to turn the board over and start a fresh. Let's at least see if these do make any sense, questions which have been raised, or should be raised. One, is oceanography a science or a group of independent disciplines working on separate problems? Two, should the La Jolla campus and its development emphasize primarily oceanography or a broad growth in all the sciences? Three, is Scripps Institution primarily a service institution? or even secondarily a service institution? Fourth, should the Scripps Institution expand and emphasize primarily biology or integrate an approach to all the problems of the sea? Five, should the Scripps Institution emphasize basic research, applied research or both? Should these be separated or combined into a single organization? Six, should the Scripps Institution be autonomous within the University or closely integrated with other campuses? There may be several other questions that someone would like to put forward. ~~xxxxxx~~ Perhaps the first thing to do is to state any other questions that you would like to hear discussed. If not we'll assume that these are the questions. (Would you be ~~xxx~~ ^{someone else} good enough to ~~xxxxxxx~~ explain to us, I think/the meaning of the word oceanography as we ~~xxxxx~~ will undoubtedly be later on, what is a science and what is a discipline, just as a matter of semantics? because I think we'll be talking in circles if we don't know what we mean by these words)

Well I'm not quite sure what I do mean. ^{Revelle} (Doesn't oceanography ^(another speaker) mean the science of the sea? and doesn't science mean knowledge?) I think that that is historically correct. ^{Bronk} (I think some reticent genius has answered your first question for you on a sheet that's passing around) (Being a ^{of Woods Hole oceanographic Institution;} the sheet which is referred to ^{introducing competition through earlier in} the evening. But apparently WHOI, which Columbus and Alfred and I are familiar with, the indications of means, What the Hell Oceanography Is.

The reason that I like it is that I remember we once had a two day discussion during the middle of the war, we probably saw the end of the war and we wanted to find out what physics was. The American Institute of Physics, are any of my colleagues here? The Institute sponsored this discussion and after 3/4 of a day I remember Albert Hall saying that we were now

Brink

in a position to say that what physics was was what physicists did. But seriously what came out of that discussion was simply this. The important thing is to have good people and to give them an opportunity to do those things that they wish to do and provide an organization which implements their activities to the best degree possible. I realize this is over-simplification, but it seems to me that this has been the basis for the proper organization and direction in any institution. I do not see how one can achieve by the implementation of the . I was interested to hear Alfred say that he was the senior biologist ^{at} the Woods Hole Oceanographic Institution and the reason he was the senior biologist was because he had been there longer than any other biologist. Then he proceeded to say that that he wanted to bring Ed Smith around to have Herbert Gasset tell him how to run a research institution to which I said I hoped he wouldn't because I think it's better to have the place run with as little running as possible, which is not always true institute on medical research I might add just for the record. But seriously what you want said about is, ^{ocean-}ography a science or a group of independent disciplines? (I'd like to ask a question Mr. ^{Chapman} Chairman. You've said that what is required is good people who will be given the opportunity to do what they wish to do. Are there to be any boundaries placed around them?) I have an opinion but ~~xxxxxx~~ I'm going to keep quiet. Who wants to answer that one? (In the absence of boundaries ^{Chapman} what will be in the long run the difference between SIO and the organization on the other hill?) That's a good question because I used to worry a great deal because I was presented with an institute in medical physics. I didn't like the term medical physics and I wasn't sure what biophysics was. I decided that the proper way to organize this, and the only way to direct it, would be to find individuals who wished to do, desperately wished to do, that ~~xxxxxx~~ ^{which} I wished to have done in the laboratory. (That's good, ^{Chapman} I'll accept that) There is always the danger I think that an Institution's programs ~~by~~ may, by inadequate direction, spread too far from its central focus. But I would think in the case of oceanography which is such a broad field for human inquiry, that ~~it would~~ if one brought into the ~~xxxxxx~~ Institution individuals who were keenly interested in widening their knowledge of the sea, there might times, even though they live to be very old , never be enough of them to wander very far from the central core, of the Institution. (Mr. Chairman I would like to ask in that connection, where does this ^{someone else}

Japanese competitors and we find them making current studies of fish production with a higher degree of efficiency than it appears we are.

Iselin But they have made a very great mistake, their fundamental analysis of what they have found is wrong. They have decided that the currents change gradually because they make their survey's gradually.

Chapman Well no I didn't gather that view. Roger told me yesterday I believe that they have ~~found it~~ discovered these discontinuity areas where the two currents meet as interesting phenomena in regard to mine warfare. The Japanese have been laying their ~~on~~ on these areas of discontinuity with a high degree of success for the last 14 years. We discovered it about two years ago.

Iselin I'll agree but their idea of what the currents are actually like are quite certainly incorrect.

Epling Pardon me Mr. Chairman, it seems to me there is one point that has been overlooked in this most recent discussion. The Scripps Institution is a part of the University of California. I define that University as a company of scholars. I conceive that that company of scholars has an obligation not only to the state but to the culture as a whole. I conceive that one of those responsibilities is to carry on the course of learning. I conceive that we should adopt only those contracts which we can honestly give to graduate students and say to them, if you do this and if you do a good job you will be prepared to do what we are doing now ten years hence. I think that aspect should not be overlooked.

Brink Well I wouldn't want to differ but who is going to do 25 years hence what nobody is doing now? I was going to try and bring the discussion so that we could leave that question ~~to~~ but you lined up the questions and I suppose it is my function to get them answered .

O'Brien I'll answer for No. 1. Oceanography is that subject which is studied from boats with the exception that I will include the mechanics laboratory at La Jolla .
 Is there any possible basis for ~~holding~~ ~~the~~ view that oceanography, what means by sea science, what is customarily meant, physics, chemistry, mathematics, biology, geology, then oceanography is not in that category. Oceanography I take it is the study of the sea and the relation of the sea to the environments of the sea. If that be the case it seems to me it must necessarily be a concerted attack by people versed in the various, possibly the

five sciences. Is this a fair statement of what I heard expressed today?

Russell I don't think so Mr. Chairman. I think that statement applies to any of the earth sciences. You can define geology in exactly the same terms. Geology is simply a little older in its development in many respects than oceanography and 20 years from now we'll put them in the same category.

Bronk I agree completely. Just how are you going to apply this of geology with geophysics? I will readily accept that but if it were laid out, well isn't geology a study of the surface of the earth?

Russell Well most geologists like to think they go a little below the surface.

Bronk I don't see any medical people here but I'd like to say that if one is not careful one gets into the sort of difficulty that medical scientists are in. There is anatomy, which is a science. This is concerned with the structure of the body, and there is physiology, a science, concerned with the function of the body. And there is biochemistry, which is a type of chemical procedure. Now you get into surgery which is a technique, bacteriology which is concerned with ~~different~~ a certain type of organism, pediatrics which is concerned with a certain age of a group of individuals; so you become completely illogical. Neither one is going to disregard logic ~~but there is no way of combining~~ or else I see no way of combining in the same line of category oceanography and chemistry. Because chemistry is one of the lines of approach to the study of the sea, just as I would put geology in that same category.

Russell an actual substance, in this case the ocean's of the earth versus the philosophical laboratory sciences such as physics and chemistry or of mental sciences mathematics. In other words you are applying these other scientific disciplines to the study of a particular set of natural phenomena in the case of oceanology or oceanography.

Redfield I think that the confusion that we ~~are~~^{are} attempting to try to put these things into a lot of cubby holes like post boxes as though you were working in one or two dimensions. I think that actually what you are doing, you start first with some more or less coherent group of phenomena. Henry Bigelow used to ~~xxx~~ define oceanography as everything that happened at

. So we have to understand that somewhat to discuss an atmosphere above it.

Redfield
 And the last piece of work that I've been thinking about ~~is~~ is the measurement of the evaporation of water at the land's surface by analyzing oceanographic data. So you have difficulties in drawing the line but the high tide line will do. Now in order to understand anything we try to explain it ~~xxxxxxxxxx~~ consistently in terms of something that seems simpler to us because we have already developed a more adequate system of analysis and understanding. So if we call oceanography a science, and I think that is a very bad word because it has so many connotations but if we call oceanography the total phenomena that we are concerned with we will then analyze that perhaps according to the principles/physics, or the principles of chemistry which are the disciplines which we employ, or the disciplines of biology which are certainly much less tangible disciplines, and then we will use ^{of} mathematics which is the discipline behind all of them. So that we are really dealing with/a three dimensional mess if we try to pick apart and straighten out some sensible way.

Fox Mr. Chairman, my question is going to be very much along the line of Professor Redfield's comments. That is to say in the first question, it appears to me there is a question within it which is a vaguer one. Independent disciplines. Do we have those? Are there disciplines which are ~~independent~~ independent? I can't allow that there are. Mathematics itself, pure mathematics is the one independent variable, but are not the rest bound together? Hence it's like a shaggy dog story to me. if they're interdependent then the question vanishes.

Redfield Maybe the difficulty is that the disciplinarians are independent, and should not be to such a large extent as they are. And the whole logic as an intellectual development is breaking down the independence of these disciplines.

Bronk I think that that's very well put and very significant. I think also there is no conceivable reason why an individual cannot sail under several pennants. Certainly in my field of biology I can be a ~~neurologist~~ neurologist; if I am to be a neurologist I must certainly be either a biochemist, a biophysicist, or a physiologist, ^{orthodontist} ~~xxxxxxxxxx~~, or histologist, or all of them. The more so the better.

Revelle Mr. Chairman, it seems to me that this discussion is very illuminating and it points to what I really had in my mind, which is that I believe that oceanography is a science, a new kind of science. Bullard when he was here a couple of summers ago said, more or less in jest but nevertheless I think there's a great deal to it, that there are only two

Revelle

sciences: geophysics and afterphysics. He was doing the same thing that I am proposing here, namely pointing out that we must deal with things, with the world as it is whether it's the earth or what's outside the earth. We must deal with the ocean or with some other area of work in the new kind of science. And as pointed out if we apply the disciplines which are the old types of science. of science, developed as long as men were having to simplify intellectual problems in order to handle them. We are now able to develop disciplines that were acquired in that way, or which were developed in that way to these very much more complex problems of the real world. Such as the problems of oceanography. Just before dinner I was having, what was to me, a very inspiring discussion with ^{Professor} Mr. Miller along exactly these same lines, and I would suggest that you call on him Mr. Chairman to state some of his ideas. Perhaps before he does that I'd like to point out that question No.1 and question No.2 are very closely related. That is if we agree that oceanography is a new kind of science which involves all of the old types, then it seems almost inevitable, that in developing the La Jolla campus, we must develop on a broad basis which includes all of the sciences, ⁱⁿ the old fashioned sense the old sciences perhaps starting out with, by focusing all the older sciences on this one realm, the ocean. But to my way of thinking at least we can hardly avoid ~~xxxx~~ ^{if} we do that, quickly expanding to include the other real things that exist in the world, including the realm of living things which certainly doesn't come under geophysics or after-physics except in a very strained definition of physics.

Brook Professor Miller, how does a group of ~~xxx~~ unsympathized, unsemantized scientists discussing such matters as this appeal to you?

Miller Well I confess I'm glad to be called upon because I think this is the only place where a lot of the have to pay for the very good meals I have had out here. But I don't want to be ungrateful for this hospitality. Yesterday evening someone spoke of oceanography being the biggest chunk of the unknown knowledge between here and the hereafter. We don't have people anymore in our group who deal with the hereafter but a lot of us come nearer to it perhaps, at least if we can start the hereafter now and run into the indefinite future. I think we're mixing up two questions and the one I would get rid of

, and that is we might agree that there would be

no contract ~~XXXX~~ science if there were no applied science and let's call it science. I think our order of discussion should be science, applied science and contract science, rather than contract science, applied science, and science; and I do not mean to underestimate the important of contract research for the future of science in the United States. I think that we should welcome contract science, contract research, 100%. ^{But} /Our welcome to contract science will be a great if it's made at the expense of either applied science or pure science. They will get immediate returns and no returns later. I don't believe that the Germans lost the war because they stopped their pure science just a little too soon but I do believe the war would have lasted longer if that were the cause of their defeat. Now I am a friend of La Jolla, let me stress that and say that frankly, and I have dreamed about it, and I see a danger in its development if it duplicates all the errors of our present institutions, which belong to the 19th century and not the present. We don't want to have another set of chemistry, physiology, and all of the thousand departments I think in the Institutions we have now. Now this dream goes something like this, and I suggest simply of getting our first question done with so that we can get on to something else. I might say that my own belief is that with the 20th century science has entered a new phase, a new era. I refer to such things as the establishment of physical reconnaissance, the turn to physical history, either one suggests that something is happening which changes the nature of physical science. These things mean that we are turning to large units, one is the universe itself which has a history, and another great unit is the earth, and the history of the earth and the history of matter can't be separated. So I would suggest that we think of an institution of science which would conceive of the earth as a unit, maybe call it geogomy or/anything we please. It has three envelopes, air, water and the earth's crust. You can't deal with one without the three, you can deal with part of one and yet there's no doubt that this Institute for some time will the sea, and the the other parts of this program of the three are envelopes/pretty well looked after in our other institutions. Nevertheless we might conceive of the whole program in terms of the actualities and not as administrative divisions. So that this Institute might well develop not into another Berkeley or Los Angeles, but as an Institute of science which is devoted primarily to the earth as a unit, It would cover what is now known as oceanography, it would include meteorology, I don't believe it's

Miller

possible to have ocean meteorology but other meteorology, it would include what geology is needed, you're not going to be able to separate marine geology from other geology; it ~~would~~ would include the life sciences in so far as these are needed in the study of the ocean, because the land animals and are already looked after. It might include geography in so far as the human element comes into this whole science especially with respect to the oceans. This at least would set down some lines of development, if we can avoid duplication where the work is already done on another campus. But it would not mean setting up all of these departments here which would be auxiliary departments. Those theoretical departments like ~~mathematical~~ mathematics and so forth. Here I think we should depend upon the other campuses and the other universities. I would think that it would be good to have small departments of this Institute, one on at least each of the other campuses at Berkeley and Los Angeles. You would have a few under-graduate students definitely devoted to coming here and of course many others that come here without having gone through that department and from other institutions.

I think you'd have an institute that could look after/^{what}special problems of applied science and contract science that came to it. I don't mean there is any problem there. I don't think that the contract work should be regarded~~d~~ as something it should be regarded as a valuable part of our system which however, must not defeat itself by interfering with those studies which make contract science and contract research possible. I mean to the contractor. And finally I would suggest that to make this program or something like it, possible, a rather ~~important~~ important immediate necessity is to have the Institute given the prospect of permanence and assured development and that means something more than the present faculty and the present budget. It seems to me to assure this program or any program for research there should be a faculty of at least 25 or 30 men and ~~in~~ a budget from the university which would maintain this nucleus as the permanent and assured work of Scripps, with a budget I suppose somewhere between $\frac{1}{2}$ million and a million dollars from the university itself. So that the changes in time of contract work would not affect the scientific work of the institute and there would not be the possibility of lapses and would not to bring here the best men available in the several fields.

Bronck Thank you Professor Miller. I think I heard you discuss this morning

Brink

relationship between the types of applicational work which I assume Professor Miller was referring to under the term contract research and the basic exploratory un__mitted, by the way I get 10¢ on every copy of _____ book I sell by referring to this term un__mitted research. Would you care to speak for interpretation of how the general proposals that Professor Miller has outlined would fit ~~in~~ into your general/view expressed this ~~morning~~ point of morning?

O'Brien Well I regard at least for us in the field of applied science, I regard contract research as highly desirable. If I had the choice of having a completely free budget and a budget that had some free money and a majority of contract money I would choose the contract money, for us in the applied science. Because I find that through contract research we have a great deal of outside interests in what is being done. And I as the administrator had an appraisal on the success of our people, of their accomplishments. I don't think that applies to basic research which should be free from this appraisal on the basis of utility. But from my stand point of being in the applied field contract research I feel is very desirable because it presents us constantly with outside appraisal, _____ have to appraise the appraiser. Nevertheless it's a constant spur. I think that in all this discussion one should remember that the man who holds the purse strings is the man who calls the tune. And I agree completely with Professor Epling in his thesis regarding the responsibility of the University, not only to the state but to society as a whole. But I do think we must remember that the state, the Federal government and the other sources of money in the long run will appraise all of this work from the standpoint of its contribution to society. It won't appraise it item by item but in the long run if the benefit is not there we will not get the money. And I think it should be true that those who are interested in science, and I would define science as the process by which one arrives at a generalization regarding the physical or social or other phenomena without regarding money or values involved. It's very necessary that the people who are engaged in that activity of providing generalizations be free of this constant appraisal of utility. But nevertheless the scientists who work on those problems are almost certainly men who once they have the generalization will admit that they want to go on to another problem. Now there is likely to be a huge gap between the generalization of science and the practical application. And if these scientific institutions don't think about that gap and somehow either through their own mechanism or by collaborating with

others, they don't help society to apply the results of research to the problems of society. There will be a great loss from two standpoints, science won't get the support it needs and too society won't get the benefits it deserves. I mentioned this morning this formal recognition of the application of science. Now engineering grew under a different circumstance. Engineering was an art before science did us any good a hundred years ago. Practically it was an imperial artistic thing. People by feeling, by experience, designed bridges and so forth. Gradually science came in and helped us in our work. And so that means that science which stems from mathematics was separate from engineering from the very beginning. But in recent years it has been necessary for the engineering departments of universities to sponsor certain branches of science which were necessary to their activity. I think it includes mechanics, transfer, , metalurgy, and . We are the sponsors of those sciences and I think they are real sciences in that they mean the generalization ~~of~~ and they are not concerned with utility. We're the sponsors of it, the engineering . And I think there's the same situation in oceanography. That a group concerned with oceanography should be composed in my opinion of those who are true scientists who are only concerned with generalizations, they want to know the truth and they don't care whether it helps anybody, whether it does or whether it doesn't, whether it's useful or whether it isn't, whether they get sardines or whether they don't get sardines. But I do think it is desirable that somehow through another department, so that whatever is learned about the habits of the sardine, somehow we'll end up with the sardines ~~in~~ in the cans at Monterrey. and resulting in ~~the~~ income to the state of California which then can be pointed to as a justification . I have a lot of trouble visualizing what is going to happen at Scripps is oceanography is a science and this Institution teaches that science as compared with the situation now, as I look around at the people who are here, as members of this staff. They came from many departments, they studied under many professors, they studied many different cultures. And here they are going and I think quite strong are relations. Now if they teach their successors and these successors stay here will they be as strong 30 years from now as they are now? That's the other problem which I can't quite get away from the idea that the strength here results in geologists, chemists, and biochemists, physicists and mathematical physicists all being mixed up together and doing this job. We had that trouble in engineering yousee, too many engineering

professors studying engineering. Now we're getting away from that. and I are getting chemists and mathematicians, physicists and physiologists all mixed in together. Simply because the inbreeding is bad, even though it's inbreeding of other institutions, we all suffer from the same sort of thing. We don't have ideas out/^{side}of our scope. My thoughts are very confused on this subject maybe, but one is the matter of application, somehow there is a method by which what is learned gets to be used. And two can any organization train its own successors? Does it every/ work out?

Bronte That was what I had in mind when I made that remark to Professor Epling that I think it's important that we/^{should be}continually considering how best to fit people to do that which will be an active field of investigation 25 years from now. Which of course we cannot plan for, but can do no more than give a person as broad a foundation as possible so that they can grow to the limit of knowledge to which we are able to proceed.

Maffield Mr. Chairman, isn't part of that answer in the way science has grown in this country? It has grown in two ways. Originally practically wholly academic, wholly pure science. Then the engineers began to take hold of it, finally industry took hold of it, now there are large government laboratories that have taken hold of it. Most of the industrial laboratories are doing applied science on down into engineering. The trend is as I see it that we are getting too much applied science for the stockpile of pure information that we're building up behind it. There is no that won't be applied with the large number of industrial and government laboratories, hungry for new information and doing only applied research and development so that our danger in this country is that we will deplete our stockpile and keep it depleted and what we need here is more of the pure research. We have built up very powerful applied research and development organizations outside of the universities, and we're constantly watching all the university work to get new ideas/ to apply. Therefore I think the university should keep as well to the pure research and the replenishing of that stockpile as possible.

in the field of oceanography

O'Brien Is there/^{is}within the university a laboratory concerned with application?

Maffield Well certainly at New London and we have a rather large oceanographic group right here at NEL, just waiting to grab anything that Scripps puts across to us.

O'Brien Does that cover the whole field of fisheries?

Maffield No I don't think it does. Because our limited part has to do with what is applicable to

the Navy. Whether outside industries in oceanography have built up the kind of laboratories that exist in the other sciences like G.E., Eastman Kodak, Westinghouse, and so forth I don't know. But if they haven't I think they're missing a bet.

Frank I think your remark is interestingly related to what O'Brien said this morning and also appealed to me the affect that if one has individuals who are primarily concerned with application in an institution such as this it relieves those who are primarily concerned with exploratory research and have little interest in application, of the feeling of compulsion to apply their discoveries in order that the functions of the institution as a whole shall be justified. This reminds^{me}/of my attitude when I was an engineer. I did not realize that those of us who were concerned with applying knowledge were aware

than those who were concerned with basic research. It was not until I became a physicist and later a physiologist that I was introduced to this point of view. I remember several years ago the Atomic Energy Commission when ~~xxx~~ we were discussing the training of healthphysicists and we decided that these would be people of the sort who would have been engineers. And the assumption was that we would award fellowships for training as health physicists, as biological engineers if you will, who had not succeeded in receiving fellowships for training in fundamental research. I remember saying that I thought this was all wrong because surely in this way we would net a very low grade of health physicist. I went on to say that I thought having been an engineer at one time that there were many people who had very fine intellectual equipment and had not the slightest desire to do research. They were very keen to apply scientific knowledge and I noticed that all but one of the commissioners who happened to be at that meeting shook their heads vigorously yes when I said there are a lot of people who think that people who do research are damn fools. The point I'm trying to make is this that I think there are people who prefer to do applied scientific knowledge in the sense that , and if they are included as a part of a group such as this they will enable most people who have a burning desire to discover new facts freedom for such discoveries without any compulsion to make application, but until then contract research directed toward the solution of specific problems is not a disagreeable thing to contemplate, as it would be for me who would hate like poison to be told what I had to do and to turn in a report on what I had done. *every 6 months.*

Chapman Mr. Chairman, Dr. Maxfield brought up an interesting point which is often heard and that I'm sure everybody knew, that the applied scientist will the research scientist to provide new information and ideas for them to work on and to develop. I wonder, I'm asking this as a question, I wonder if there is not a goal of information ideas, and inspiration in the other direction also? I wonder if that is the case and if that should be the case would not Scripps be stronger if it maintained its research program in tact and strengthened and had applied scientists working in close conjunction with the others.

Revelle I ~~know~~ thoroughly agree with this point of view. I think it's very true that you get a lot of good scientific (Chapman: I didn't ask the question from the point of view, I was wondering whether that situation obtained) I think it does definitely. We get a lot of good scientific problems and/scientific ideas from considering the practical application.

Bedford engineering as thing set apart from science. My introduction to engineering was perhaps at one of the lowest levels because I was called in on consultation in connection with the paint industry, and it seemed to me in thinking about that experience that engineering ranged on the one hand from pure witchcraft and cook bookery to ~~xx~~, on the other hand ~~xx~~ a very explicit and exact application of fairly clearly worked out principles. In other words strongest or lightest or something like that. That's a fairly well worked out thing, and the conventional engineer and equation and then does some arithmetic and comes out perhaps correct. But if the paid chemist ~~xxx~~ tries to do the same thing he finds that there is no or very little basic science that he can turn to so his procedure is entirely empirical. Now it seems to me that where you have an engineering problem which is difficult beyond the ordinary types of perplexity, it means that there is fundamental knowledge lacking. And it is the discovery of those things that I think would be ~~xxx~~ a very great impetus to the scientist in showing him new problems. I think the whole great subject of underwater sound is a perfect example of that. Twenty years ago no oceanographer knew anything about underwater sound. The practical application of it has lead to techniques into the study of detailed phenomena of the sea which are vastly illuminating to science. So I think that an Institution such as this profits immeasurably by having within its own walls the people who are concerned

primarily with these applications.

O'Brien If one wants to be a little unkind, I think it's reasonable to say that almost no problem of engineering is solved by science or by the application of your physics handbook or textbook. And that when applications are made it's usually found that there are discrepancies between the expectation and the practice, and in ~~xxx~~ many cases those discrepancies are then as you say the lead on some scientific development. I remember recently that we had a visit at Berkeley from Sir Charles , and a group from the ministry of education. They were concerned, I don't want to speak too much of engineering, the problem in Great Britain ~~Britain~~ was to educate more engineers. The English universities are concerned about having all these people on the campus because they would swamp the rest of the university and as Sir Charles expressed it, ~~the engineering is~~ engineering is swallowed and the university

Brown Well I think this is because, if I may say so, a very limited attitude toward engineering in Great Britain. It's never been properly respected in the sense that Dr. Redfield has referred to engineering. Are there any other thoughts that anyone cares to direct to the second question? I have it listed on the board.

Hutchinson What I wanted to say may sound a bit strange at first. I think it's probably exceedingly relevant. Those of us in that position I think are probably sitting around here in a kind of vacuum; we're not perfectly certain what we're for and we wonder whether the people who are in the great group of engineers are regarding us merely as people who can find something and it gives us uncertainties, the so called pure science

and this morning Dr. Revelle made a remark about the Venice . Now if there is any place that I would rather be than southern California it's probably Venice . . I can't think of any other place. And I started thinking about Venice casually and it seemed to me there perhaps was the opposite of what I was trying to get at. Particularly the activities of who painted a very beautiful picture of a nude lady which she called went to Vienna came to New York and as far as I know never

for a reason that I cannot possibly explain and I don't understand but there it is and it seems to me that the same sort of reason is a valid one for what pure science has found. I think there probably may be some sort of neurophysiological correlate to it

that might be discovered but I doubt that it would carry a great deal of conviction and absolutely no emotional conviction at all. Now the question arises as to what the attitude ~~xxxxxxxx~~ Phoenicians perhaps of the ~~xxxxx~~ would be about work of that sort and I think that I'm not overstepping legitimate historical speculations to suggest that they ~~xxxxxxxx~~ ^{were} probably exceedingly proud of that type of activity. They certainly encouraged it on fathomous scales but didn't catch any tuna ~~xxx~~ whatever they were catching ~~xxx~~ in the Adriatic at that time. Now it seems to me that we also have to look a little bit to the sort of commemorations/^{we}were engaged in this afternoon and wonder what the past means to ~~xx~~ us. As far as I can see what it means is people telling us things, people talking to us, and people to whom we cannot reply, or even express any real appreciation. And we are in the position of people talking to the future and they cannot say anything to us, they can't tell us whether they like us or not. We can only do our best. And what I want to say is this, that if we are sufficiently trying in what we are doing in pure science I think we can have some sort of faith in the people of the future who look back and like us. I still don't know why they should any more than I know why I think ~~was~~ ^{was} exceedingly important. And I think that if all the work that we've been discussing really ~~x~~ very deeply and fundamentally to take that point of view. And use what we can but not worry too much about what we don't k use and still be very pleased ~~with~~ ^{that} we've done it. And I do miss that last point of view in this discussion and it may clarify the type of ~~xxxx~~ ^{argument} that we've been engaged in.

Brink
I think you've expressed what a great deal of us feel very strongly.

Reville
I'd like to make one remark if I may, Mr. Chairman. The author that I widely favorized in stating this morning about California being the ~~of~~ of the 20th century, the author of it wasn't here. And to use it again I must point out that ~~thought~~ ^{thought} of it not me.

Lockhart
One thing that hurts me about what Dr. Hutchinson was talking, ~~xxxxxx~~ ^{as an} example of what we should not do. There were two men not too distantly removed from Venice who have come down to us in history, Leonardo Di Vinci and Gallileo. Both of them have a mature place in the ranks of people who have contributed to society, contributed things of great value. But there is a blot on the ~~, as~~ ^{, as} both sought support from the governments of the time by promising to invent military machines which they did not produce.

Reville Mr. Chairman, what is the moral of this fable?

to check I think we should watch ourselves. We are perfectly justified in demanding the right to do pure science, but we should not attempt to get that right by promising something that we're not going to deliver. If we promise to deliver something we should deliver it.

Blunk I would like to draw another moral and that is this, from what _____ and Carl both said, I think scientists have themselves in part ~~xxxxxxxxxxxx~~ prostituted science by feeling that it was necessary, or acting as though it were necessary, to justify their endeavor on the grounds that ~~xx~~ it is practical and useful. I don't think I ever heard a musician or a sculpture or an artist or a poet say that he deserved his support from society because he was going to produce something that was physically useful. I is recognized that this is, somehow
Hutchinson
is as ~~xxxxxx~~ has stated, satisfying in a way you can't explain and large sectors of society are perfectly willing to accept this. I think that if they were enabled to see science, large sectors of science as an intellectual adventure, that is one of the most thrilling of the adventures of the human spirit, I believe they would be completely satisfied that we should do this. But if we do this with part of our spirit but not with all of our ~~xxxxxx~~ spirit, I'm afraid then ~~xxxxxx~~ they are going to think we are little phonies about this and will not believe what we say. This I think is not in the least in contrast with the importance of doing practical applied research when our discoveries are ready for such application. And I think this is not meaningless to those I have implied who are most concerned because of certain intrinsic qualities of the translation of ~~xxxxxx~~ knowledge into human welfare which satisfied physical needs are any less important than those who are interested in doing what they do because they want to do it, then I _____ the imagination has gone to the horizon of people whose lives are rich by ~~xxxxxx~~ virtue of that. ~~I think that xxxxxxxxxxxx~~ It seems to me that oceanography has a, I speak not as an oceanographer but as one who has since a small boy been passionately devoted, the reasons as Hutchinson said about the _____; I cannot explain why the sea awakes in me tremendous emotion but I can remember sitting on _____ as a youngster and looking out and thinking _____ and rising in me a tremendous thrill, I do not know from that time until this, the very sight of the sea, the hearing of the waves on the shore, _____, the navigation of a boat over water which has beneath it rocks _____, it does something to one. And I think

those of you who are oceanographers and who can constantly see the terrific impact, the thrilling impact of the sea upon the ^{whole} / lives of the peoples throughout the ages and the opportunity to awake a tremendous emotional appeal among peoples, as well as the practical contribution you can make in getting more out of the /, more scientists out of the .

Revelle I agree with everything you say but I want a statement of it. We'll treasure that for years. I'm very much interested ⁱⁿ the story Dr. Eckart told us because it seems to me it's quite a complicated story. Both ~~Galileo~~ Gallileo and Leonardo Di Vinci produced many practical things actually. Their mistake was to promise something specific. If they had been more sophisticated ~~in their predictions~~ about their own capabilities they might have prepared a research proposal that was more honest.

J of After your remarks I'd like to quote a brief remark from Dr. George Culbertson whom you all met today who once made a statement that is worth pondering. He said "There is very little difference between the truth, ~~the~~ /, the true scientist and the ~~the~~ truth of a basic character!" And when asked for his definition of true living his response was something like this, "That it's giving the best that you have, to the highest cause that you know without counting personal costs."

Brink I take it that it would be pointless to take issue three after these remarks, the question ~~is~~ being, is the Scripps Institution primarily a service institution or even secondarily so? I would myself regret ^{any} / any one of the ~~few~~ ^{few} oceanographic institutions in this country would be merely service institutions for emotional, spiritual, as well as practical reasons if they were. I don't know from whence would come the information to enable service institutions ~~ten~~ years from now to render their services.. Am I brushing off that question too quickly?

Chapman I would like to speak for that question Mr. Chairman if + might.

around here this evening I find

this morning I came upon

the word service. I had a definite thought in ~~my~~ mind which was not the thought which I transmitted apparently. I think this is not with any assumption as to whether this is good or bad. I believe a research institution which does not provide a useful service to society, whether it will be in short view or in long view, will cease to receive support for

Chapman
its work as soon as its supporters discover that fact. On the other hand a research institution which provides useful service to society in the long run, as long as you want to run, will thrive, and that's what I meant to get across this morning. I don't say ~~it~~ whether that is good or bad; I say that support will ~~not~~ be forthcoming.

Sallicker But society has a very view of service fortunately. It seems to me very interesting that you get so much enthusiasm for 200 inch telescopes, ^{things} which are very imaginative projects in science. The benefits are far and uncertain. There is a very fundamental streak in people which causes them to support these things.

Chapman That is very true. I meant to imply that this morning when I referred to the fact that as a biologist as the fishery people, the work that I have come in contact with in the last two days that caught my interest most and I thought would strike the interest of people with similar training as I have was ~~not~~ not the biological work at Scripps ~~but the physics~~ as much as it was the physical oceanography being developed by and Dr. Munk..

Suits It is that the minds of men need food as much as their bellies.

Brink I feel very different sense than was intended. As one who has spent a great deal of time in the military and who has a very great fondness for the and privilege to serve I remember interpret what implied. In terms of service when it was merely rendering something specifically requested of a practical utilitarian nature, even that I would completely respect, ~~except~~ except that the question was posed is the Scripps Institution primarily such an institution?

Chapman Before I leave I want to make a remark on what Dr. Hutchinson said. He posed the problem which has, wondering whether or not he is doing something that justifies or not. I think the applied scientist who is doing something which is obviously useful has often the same inferiority reaction. I say that myself because I've been on that side of the question.

Miller Mr. Chairman, it's difficult for me to see that this discussion will change or can implement decisions. I think we are all sure that the Institution will continue to provide long range and short range services. The question as between the long range service and the short range service is not one that can be determined by a formula. That's a matter of experience and circumstances. It seems to me that the question at the time being before us

Miller

is the development of the Institution largely with respect to the fields to be covered and the directions in which the development should proceed. With every assurance that these directions will be long range and therefore short range services.

Brink That I think leads logically to the next point.

Revelled I'd like to defend the point of view that the Scripps Institution should be a service institution. And this is somewhat of a diversion. I spoke this morning about the fact that we are to some extent tied to our ships and limited by our ships. This particular problem I feel can be partly solved in interesting other scientists in the use of our ships, scientists throughout the university and throughout the country. These Scripps don't belong to the Scripps Institution. They belong to the University of Calif. and we would like to see scientists from all parts of the university take up problems that can be carried on on our ships and come down here and do it. And we would likewise like to encourage scientists from other institutions throughout the United States to do likewise. So at least in this sense it seems to me that the Scripps Institution should be a service institution primarily to other scientists. Secondly we will maintain these peculiar and unique facilities for scientists who can think of something to do with them anywhere in the country or in the world. Of course this question as it was stated there, was really ^{a rather} ~~un~~fair one but it seems to me we have illucidated it in the proper sense. Both Mr. Chapman's and Mr. O'Brien's remarks have pointed out that no university, no academic institution can indefinitely exist unless it ~~xxxxix~~ serves society. The only real question is the time constant, involved.

Sauer I'm a little confused here as to service. Is this what Mr. Chapman means by speaking of something obviously useful?

Chapman I'm thinking for instance of the work that is being done on internal waves which would appear at the present time to have very little practical relationship to the fishing industry. I think it may very well in the long run lead to other lines of research. If that work is not directly ~~xxxx~~ useful in the long term it may very well stimulate thinking along lines that will in the long run be useful. (This is not obviously useful now but ^{if} it pays off in the fishing industry it is) No. I'm speaking only from the aspect of the fishing industry, I'm not speaking from the aspect of society as a whole.

O'Brien

I sort of feel that Mr. Chapman's remarks are somehow related to mine. I'd like to remind you along this line of what I said this morning. Scientists should once and for all forget utility, it has no bearing on what they do. It detracts from their effort. They should do their job and all we should think about is what can society put aside for that effort, through contracts, through state budgets and what have you. And once and for all let those people do their job, that's the way to do it. They shouldn't be worried about utility.

But I think another group of people somewhere look at what comes out of that application . But there are another group of people, close to them, friends with them, and they understand their thoughts. But I think it's a great mistake to have the scientist talking about utility. That's what the forestry people did. You don't have to justify trees.

All they had to do was say that the tree was beautiful, let's have more of them. Once they got to talking about trees save water, and trees do this they ~~xxxx~~ got into an awful mess. And it was a terrible mistake on their part. They had all the money they wanted if they just kept quiet and said trees are beautiful, lets have more of them. And I think that's what the scientists should say.

M. J. Wells Wasn't it Faraday who asked the liked the induction into
~~xxx~~ Royal society, what earthly good that was. I've heard two answers that he is supposed to have given. One was, What is the good of a new born baby ~~except~~ its future possibilities. And the other was, Well I'll bet you'll tax it someday.

Eckart I've been thinking over what significance there was to my being reminded of Gallileo and Leonardo and I think possibly if we ~~thinkxxxx~~ O'Brien's last remark about the
accept
flow of people he has said it more clearly than I had.

O'Brien I wonder if we've reached the point where I can tell a story about service. .Perhaps you've all heard it, About Will Rogers speaking at a dinner given at the Standard Oil Co. There'd been much talk about Standard Oil Co. rendered service, and Will Rogers said that he had been raised on a farm and his father owned a bull. And as a young man he ~~he~~ learned about neighboring farmers running their cows into be serviced. So one evening he saw the cow come in and he had reached the age where he wanted to see what was going on and he looked over the side of the stall and said "gentlemen, I saw the bull doing to the cow what the Standard Oil Co. has been doing to the public for the last 25 years.

Brink I think that before we leave this point that Roger has raised a most interesting development that has taken place in science, and that is the provision of central facilities for research. It's going to make more economical the operation of universities. I'm thinking of installation, the facilities universities all over the country can go and have access to physical facilities that no university could provide except at terrific expense. And this I think is extremely important. It is one thing that I always find the of budgets always listen to with rapt attention. They can understand this I think greatly so. And this is something I think which is going to spread. It is one of the good developments of governmental participation in science in addition to the ~~xxxxxx~~ specialized facilities of various institutions such as this and Woods Hole. From the broader realm of science the big centrifuges for human use that are being developed by the Navy in Philadelphia, at Wrights field are again typical of facilities

Revelle I think what we're really talking about here is the formulation of the questions. If you formulate them in terms of, for example, what controls the population of the California sardine or what determines where it is going to be. That's the kind of question that the applied scientist can conduct research on or the pure scientist as far as that goes, and feel that he's doing a useful and important job. But if you contract, or attempt to make a contract for a specific piece of research, not to ask the man to ~~ask~~ ^{attack} a specific problem but to make a particular kind of measurement, then it seems to me this is bad. For instance if you say to the Scripps Institution we want you to measure the currents in a certain area in order to solve the problem of what controls the population of the California sardine, it seems to me that this is not a proper or effective thing to do.

Brink Would you decline to accept the contract requesting as specific information as that?

Revelle Well it would depend on the urgency of it, and I don't know whether you can give a categorical answer to it. But in general it seems to me that the applied research problem should be stated in terms of what the problem is, not how you go about trying to solve it.

Sping Mr. Chairman, it occurs to me that there is another aspect of what is sometimes thought of as being applied research which might lead to some misunderstanding in this respect. Both Dr. ~~Sxx~~ Schaeffer and Dr. Chapman used the word population dynamics. They were thinking in

copying
 terms of fisheries. They were thinking of the rise and fall, the increase and decrease ~~xx~~ in the population and their movements. Now a part of their understanding of those populations and the productivity might be gotten, not just from the sardine because it might be a very unfavorable material. And in order to get that information, one might for example
 or something that has no ~~xxxxxx~~ relation to the sea because it is a material.

the practicalness of the legislator may think that the problem is not actually to be pursued but is actually a fundamental issue.

Brink That's a very important point. I've been very much pleased recently by the general attitude of Washington with regard to the importance of just this point of view. I would have thought that the international situation being what it is, that this point of view would be suppressed but on the contrary I find that it is, it may be an ~~xxxxx~~ accumulation of previous educational actions, but I think it has been more generally ~~xxxxxxx~~ accepted during these past ~~few~~ ^{eight} months than I've seen before. I think it is extremely important for just as you say, that the investigator shall be given freedom to decide

Schaffer Mr. Chairman, I would like to make one remark to add to this discussion of population dynamics. This is a fitting example of what we were talking about. Population dynamics may be approached

in fact that is one of the greatest needs in that particular search. Whether pure research or applied research I think it's a question of attitude rather than

Brink Roger, how about the next question.

Revelle Well, the fourth question again is designed rather thoughtlessly and primarily to arouse discussion. What it says is Should the Scripps Institution's expansion emphasize primarily biology, I might equally well add here physical oceanography, submarine geology, or any one of the components of oceanography, or should we make an approach to all the problems of the Sea? This may sound like a straw man but actually we have received recently two letters from responsible and pure scientists. One letter says that the author would deplore expanding our emphasis on biology because we ought to concentrate primarily on physical oceanography. The other author says that isn't it ashame that the largest marine laboratory in the world is going such an inadequate job of biological research on the ocean.

Brink Alfred, you're an unprejudiced real
Redfield Well I've been trying to make up my mind if there are/alternatives there. I would almost be willing to state that an intelligent expansion, which is primarily biological would include an integrated approach to the problems of the sea, and certainly an integrated approach to the problems of the sea would include a very adequate treatment of biology. I think that the question is almost academic in character.

Brink Columbus, you have seen it from the other physical point of view.
Selvin I just feel that marine biology hasn't gotten its fair share of biological money and the only supporters of marine biology essentially today are these two institutions. And that very little of their money is labeled biology. We have to most of the biology that is done but this is something that is the biologists rather than these institutions. It is for the biologists to make up their mind whether they want to turn their backs on the sea or not.

Chapman experience 3 or 4 months back
 I had a rather interesting / which I think perhaps has a bearing here. I dropped into Roger's house for a drink one afternoon and developed upon arguing on this question and I found myself defending the position that Scripps should go forward more actively in the physical and chemical oceanography fields. I was speaking as a biologist. Roger took the other side of the question to stimulate I my argument. ~~He~~ became puzzled and began to wonder whether my interest in Scripps following in the physical and chemical oceanographic fields was perhaps because I didn't understand very well these fields of work. I understood fairly well the biological field and everything I sawly even ~~xxxx~~ dimly in the physical and ~~xx~~ chemical oceanographic fields I could see possible applications in my own field and therefore I wanted Scripps to go forward actively in forming these other disciplines from which I might obtain gains. And I wonder that/partly didn't gave rise to those two letters, which Roger received, people ~~xxxxxx~~ wishing to have other disciplines pushed so that perhaps they could get a little stimulation in their own disciplines.

Brink One of the things you have I think
 very important, that is looking at ^{it} from the biologist I would say that you're so right in emphasizing the fact that an important development in physics and chemistry is the most important thing that could happen to biology. Because we never know.

Chapman Dr. Schaeffer brought out this afternoon that the problem of sardine population dynamics was very like the chemical and physical oceanographic problem and the biological problem.

Brink Dr. Brinks, a question that has occurred to me in the discussion that is taking this turn, is especially relative to Columbus Iselin's remark. Why is that marine biological laboratories do so little marine biology? I speak as a long time resident of the Marine Biological Laboratory at Woods Hole.

Brinks Yes, I have ~~xxxx~~ watched that too and I was trying to think of the history of marine biological stations, of which there have been many of course. And a great many of them around the nineties were all subject to ~~xxxx~~ and such things developing.

There is always the tendency for a nice station to build up and then people to bring their own problems to it and not look to the ocean. We try of course to resist by keeping our eyes on the ocean. But we can't look far out on the ocean which is our difficulty at the present time. I think on this coast that there are 5 or 6 biological stations which for sure aren't getting very far away from the shore but they're getting their feet wet at least. They're concentrating on marine problems almost exclusively. ~~There are as many on the East coast. That is why I think that when we have a few oceanographic institutions they might well concentrate upon the physical and chemical aspects forgetting . But biological stations are doing their best~~

~~Yet even then they work so frequently on, when they work on marine forms, they do so~~

Brink Yet even then they work so frequently on, when they work on marine forms, they do so only because the marine form happens to have the type of structure which enables them to do what they couldn't do with a little more difficulty on other forms.

Brinks Well I think it's very fortunate that the sea has its fish and brings its people to the sea shore.

Brink I take it that there is no one who thinks that the Scripps Institution should be entirely a biological laboratory.

Beville Isn't it ~~xxxxx~~ true that the really central problem of the ocean is a biological problem?

Hubbs Mr. Chairman, certainly we are trying to draw lines here where there are no lines. I think we have to acknowledge that much of the support that has come to oceanography are contracts. They are certainly making it possible for this Institution to do a great deal of work that they would never otherwise do. Certainly it's paying back a very small part of the debt, which specifically society, the Navy, owes oceanographers. I need to refer to only one paper, that Mr. Iselin and Mr. Ewing wrote in 1940 I guess it was at the beginning of the war. And if oceanography hadn't done anything but that, that was in the field of physical oceanography, specifically the affect of temperature gradients and gradients on the refraction of sound in the water. In general ~~xx~~ civilians and naval officers alike who had been studying that problem

only way that they characterize the effect of sun shining on the water. We owe, to be sure, a great deal to these people who did that work and in turn now much of this work in physical oceanography that Hubbs refers to now is certainly something that we have to do. We're not altogether free agents, I'm not sure it's good that ~~x~~ we are. These things aren't going to damage us a great deal and that we have all of these disciplines working together, we have the pure and the applied. I'm sure that all of us have had experience ~~xxxxxxxixixixixix~~ with enough to know that the thrill we get of working on a pure problem isn't very much different from that which we call applied. These are words after all. My own experience has dealt with two problems largely, one which could be called engineering, one definitely in the field of architectural acoustics, and another pure physics in the field of electrical . And I can't frankly distinguish the difference between the internal satisfaction that you get from discoveries in either of these fields. We are working, biologists and physicists and chemists , we know we have to have them here; we know it would be a mistake to inbreed just oceanographers, or train your own oceanographers. Our common sense will dictate that we should bring men in here, knows very much about the ocean, excuse me Carl.

because he brings a fresh approach to these problems. We shall ~~xxxx~~ always be doing that .

We may bring many engineers, certainly can bring things also to bear upon these things. The , it seems to me if we throw all these things together we've got and we can't discard too many things now. The contract research

Knudsen
differs from the research that the University sponsors, largely, I think more than anything else, in that the University can afford to grant a \$100 or \$200 or \$300 for a project and contract research can afford 10 or 100 times that amount. And we have these two types of projects going on within the Scripps Institution; we have them going on within other universities. Approximately a year ago I prepared a report on research at the University of Calif., southern section, which happened to include Scripps Institution at that time, and made a list of the research projects which were representative of the work, ~~that~~ the research being done by the University of California, southern section. And I doubt very much if we put an asterisk after those projects which were supported by contract that you'd have great difficulty just reading the titles, knowing which were supported by University of Calif. funds and which were supported by contract. The projects which I know intimately which are supported by research contract funds are quite indistinguishable from those that are supported by university funds. So we're drawing distinctions I think between the pure and the applied, between the biological and physical, that pretty well disappeared in our actual operations. Dr. *Revelle* is particularly successful in some of these biological problems because he brought physics and chemistry to bear upon those problems. Most of the biologists who are in the vanguard? today will have to use increasingly in order to make progress in that profession. And so we have to use all these disciplines here at Scripps.

Brand You might reply to Dr. *Revelle* when he asked why should not be primarily or exclusively emphasizing biology by saying that it could not further biology unless it were to strongly support research in the physical and chemical aspects, of the sea.

Reynolds Mr. Chairman, I would like to confess my complete/ ignorance on one aspect of this subject which is of great interest to me, which I feel has been somewhat lacking in the discussion throughout the day. That is that some juncture in the program by which we might have had an historical background or some explanation, shall we say, of history in oceanography. This is rather a heterogenous group. I cannot help but feel that much of the ground which we have attempted to cover today has been covered by our forefathers. There was a time of course when oceanography was carried perhaps in a more modest scale than we do today, but nonetheless if we consider the 19th century world it must have represented an effort in terms of national

Putnam

~~xxx~~ wealth, perhaps even greater than what we are willing to spend on it at the present time. Yet much of that work must have had no appreciable applied value in that period; such an undertaking as the challenger . It must have been done purely for the gathering of knowledge, for exploration in the very truest sense of the word. And yet when you consider, perhaps I'm wrong in this, the growth of oceanography in the United States in it's earlier aspects, at the time of, let's say, , that had a very down to earth, practical application. It was an effort to achieve a better understanding of winds and currents in order that the wind-driven sailing vessel could achieve more efficient crossings of the equator, or find perhaps a better route to circle the Horn. So you have at that time a combination of both the applied and the pure science. Are we not in large measure today covering ground that was done by our forefathers? They did much of this and yet I feel they didn't have to justify the strain or struggle or decide whether trees were worth saving or not.

Brink This seems to me to be a most significant suggestion unless there is a comprehensive authoritative history of oceanography. Is there such a thing?

Dealin Mr. Chairman, one lecture that I give each year is this and I think the answer is actually very simple. Physical oceanography started because the famous biologists of the world needed a young man to read their thermometer. This is the way it started and about 1900 the famous biologists were no longer interested in the ocean. But the young men who had read the thermometers ~~xxxxxxx~~ kept right on reading them and about the time that I was a graduate student, Dr. Lowell ~~xxxxxxx~~ marine biology courses said to me that he was stumped, he didn't know quite what to do in the ~~xxxxxxx~~ until somebody had worked out the circulation that he couldn't understand the whole quantitative and qualitative of the ~~xxx~~ marine biologies and we've been about 20 years now actually answering the question which Dr. Lowell put to me, and I myself is that if we have answered it. Basically we have answered it, we've pointed out methods, we've provided schools, we've provided ~~xxxx~~ good schools for quantitative of marine biology, and now we don't find the founders of this subject coming forward and doing something about it.

Brink But wouldn't it be encouraging to this point of view, and wouldn't it be a most important part of the intellectual, cultural period of man. It's the sort of thing that Dr. Putnam has

Blank

suggested . For instance I've often wondered when did people harbor first chart the depths of a ~~xxxxxx~~ so that they could come in. I am so accustomed to expecting to find , and cans, and guns that if they weren't there I would be appalled. I wouldn't know how to proceed. Now I haven't slightest idea when this was first done. I take it that during the Revolution Long Island Sound was relatively poorly charted. How far back does this go, 300, 400, 500 years? If not how did they get about? If one reads that magnificent classic ; this is/wonderfully revealing pair of books about the certain chapter in oceanography, if you include the evolution of sail, and schemes whereby the whole strategy ~~of~~ and tactics of sea warfare was changed. But when you go back beyond that usually the only books I can find are these rather superficial ones describing lovemaking and very little about the sea. If this is an important thing I have not the slightest doubt that a considerable sum of money could be secured if there was any desire to have this done. Because I know some years ago the four research councils, research council, had a project for the writing of the history of science in America. With tremendous enthusiasm for the support of it we bogged down/ not finding anybody who'd do it. Perhaps that is what we would find here too. But I raise this as a question ~~xxx~~ if there is any consensus of opinion at what Dr. Putnam suggested would be desirable it could be done. I'm sure there are those who ~~would~~ think it would be desirable and that it could be financed, provided there would be an individual or a group of individuals who would be interested in doing it.

Revelle Mr. Chairman, there have been several attempts of course. There's book of the Founders of Oceanography, there's Johnson's book, called a study of the ocean. There's one in particular by Henry of the Gulf Stream,

However if I may do so I would like to return to the question of the expansion of biology. It seems to me there is a real question here. ~~xxxxxxxxxx~~ At the present time ~~xx~~ we have as ~~Jay~~ John has pointed out, not done by any means a thorough ~~job~~ or good job of physical oceanography, but at least in the last few years we've gone ahead a lot further it seem to me to the biological work primarily because the biological job is so much . There are

Revelle

so many more biological problems. I have no idea how many organisms there are in the sea but there are far more critters in the sea than there are currents in the sea. And I feel we could actually do a tremendous amount of basic and far reaching biological work if we could interest more biologists ~~xxx~~ ⁱⁿ working on these problems; and we have to find persons' interested in working on biology, and secondly of getting them on our staff and supporting them. At the present time we've really had great difficulty in supporting them. The most encouraging thing that has happened recently here at Scripps is that the Marine Research Committee of the State of California has appropriated \$45,000 for the year 1951-52 to help us expand our biological staff. This ~~xx~~ is the first honest-to-God money I've seen in a long time for the support of biological research of the sea. Now we may not be able to spend that much because we may not be able to find biologists who are competent and interested in working on oceanographic problems.

Chapman Mr. Chairman, I am very interested in Dr. Iselin's and Dr. Revelle's remarks. And speaking of biologists there is one type of current that I don't understand very well and those are the vertical currents, how they are to be measured, and ^{physical} in our system of thought. How on earth do the/oceanographers have those quite well worked out?

Revelle Well we certainly have not of course. ^{had we probably} wouldn't admit it, because we've got to justify the fact that we've got to do more physical oceanography.

Iselin What was worrying me actually is why the ^{of vertical currents,} occur, why they vary from season to season, and how we ~~xxx~~ go about predicting how the range is going to follow.

Iselin That is just what I was saying this morning. The bottleneck in physical oceanography is meteorology.

Shepard I think there's also a bottleneck of personnel which is in biology. I think some of these problems would be helped if they were deliberately attacked. But the few people who are available are working on other things at the moment and those who ~~perhaps~~ ^{kept} perhaps might have worked on them are/so busy with the routine/ work of organizing the, to make specific reference to the

Shepard Mr. Chairman, it seems to me there are perhaps some other bottlenecks in physical ocean-

Shepard

ography, that have direct relations to submarine geology. I've asked many physical oceanographers, well how about the currents on the ~~xxx~~ bottom, for instance under the Gulf Stream? And what do we find? We find the only measurements, I mean actual observations, were made about 16 years ago or something of that nature, and they actually do not know. Dr. Sverdrup I suppose, ~~x~~ you'd say oh well we can calculate what the currents are. They can't be very strong over Plateau. I said well then why isn't there any sediment being deposited there? Well he didn't know, but then presently the Woods Hole group began to find out that the Gulf Stream was much stronger than had been supposed. He said well I suppose that's the ^a explanation, that we still don't know how deep those currents go and how they are effecting *Reel 15* the bottom.

of lower California. The general idea was, I think Dr. McEwen first pointed it out, that ~~xxxxx~~ south of the points is very low temperature. Well physical oceanographers, as I understand were rather loathed to believe that such things could exist, but they have found that they definitely do exist, and as Dr. Hubbs will tell you that ^{there is} 10 degrees centigrade difference between the temperatures on the south side of the and the north side certainly am very ignorant of this problem but as far as I know that has never been very well explained. I think in some ways physical oceanography should catch up.

Jackson I think you've raised a very nice point. We are not particularly interested in the same problems that you are interested in

de Chark Apart from these technical questions, I don't think Roger is trying to imply that there is no work to be done in physical oceanography. There is an enormous amount, there is much more to be done than there are people to do it at the moment. Every time anyone attempts to do some, particularly if it's a new kind, new and interesting results are obtained. There is every reason to support physical oceanography. No one, I think, is intending to argue against that. And also I agree with Dr. Shepard that some of our previous theorizing has been rather schematic and should well be improved. But I think nonetheless it would be very unfortunate if oceanography were confined to physical oceanography and the support in the past has tended toward an over emphasis of physical oceanography relative to biology. Both could be pushed harder. Both suffer from the lack of people. The biological work ~~ix~~ has

also suffered from lack of finance.

Chapman Now Mr. Chairman, we come back to Dr. Rakestraw's thesis of eliminating the training of people. (You mean in number). Yes

Revelle May I answer that statement? Actually the answer has already been given but I would like to emphasize it. That is to a very considerable extent oceanographic problems can be most satisfactorily attacked by people who aren't trained in oceanography at all. One example has already been cited, ~~by~~ Dr. Eckart. Another example can also be cited by the people in this room, two other examples, those are Mr. Isaacs and Mr. Snodgrass. Most of the results in physical oceanography, not most of the results but many of the results in physical oceanography that we spoke about this morning, for example. Two cases that I might mention are the measurement of waves and the measurement of gradients in the bottom, are subjects of profound importance. We wouldn't have gotten anywhere if those two men hadn't developed instruments for making measurements. Take the problems of biological oceanography again. Some of our most successful attacks on biological problems has been the development of big high nets for underneath the waters of the ocean; which wouldn't have been possible if Isaacs hadn't applied the things which he learned completely outside the field of oceanography to this problem, namely engineering. Considerations which exist in the problems of, of frictional resistance, forms, and pressure against various parts of the net. To a considerable extent many oceanographic problems require, as has been pointed out repeatedly here, the application of knowledge which is never learned in oceanographic institutions.

John Mr. Chairman, several to discuss the general question of the unity of science more or less, to discuss physics and chemistry and no one so far has pointed out how can be very too for physics and chemistry. I think a very outstanding example of that is the experiments of Mendel who planted bees in a monastery. He was followed by and his school, who was followed by and his school. And they have given us the most powerful tools for the studying of. And without that tool we would not know nearly as much about the synthesis of the as we do at present. Some of the experiments would be absolutely impossible

I would think that would be a good note on which to bring the discussion to a formal close.

And much has been said here certainly to demonstrate the remark Roger made yesterday. I know many of us who live in California will have some occasion to help drive that home to the Regents. It was addressed primarily to them, mainly that the bottom has not dropped out of oceanography. We recognize the current great price, the condensation of wisdom that Alfred gave us here on our first evening, which has been quoted often. I know he has another to match it which we heard at breakfast this morning and I hope can be persuaded to tell us about ^{it} here today. Charlie and I know are leaving early. They come from an Institution which certainly we all look upon with a great deal of pride and envy as having accomplished I know many of the things that we strive for in connection with all of the units of the University of California, particularly this one at this time. Dr. Bronk certainly comes from a place whose traditions are those that we would like to imitate, and both and Iselin certainly have much to contribute from the experience of Woods Hole. Two of these men who have not spoken to us yet but must leave early, therefore I'm especially eager that we begin this meeting by hearing from them. Charlie I wonder if you'll start this out? We've spoken a great deal about physics and biology, using these two physical and biological last night. It seems that this is a good way to start this discussion to hear from the physicist and biologist ~~especially from~~ especially from an Institution where so much success the efforts, a relatively new Institution these two disciplines.

Charlie Thank you . I feel singularly unqualified to talk about oceanography because I know nothing whatsoever about it. Also I feel that anything ^{can} I say has already been said much better, particularly last night. And the only thing that I can

I am convinced that oceanography is a science what I mean by oceanography or what I mean by a science. Also I think that Scripps Institution is a ~~xx~~ very great institution. And the reason that it is great is because it has contributed so much to making oceanography a science. I hope it will continue in that direction and that it will think back and see what has made it a great institution. I don't mean a big one, I mean a great one. I think if you take stock and see how this was accomplished I think you will always come to this answer, that it was done by a group of men who were devoted to what they

Charlie

wanted to do. I sense here as I do in other great places

. I think this is what drives a man to do the things that can't be done
 And this is how we build great institutions. I don't believe you do it by doing project work
 and contract work, not because I think applied science is sordid, not at all, I think It's very
 important, but I think applied science carries with it an implied promise of results, ~~xxxxxxx~~^{which}
 in basic science, fundamental science you cannot give and you must not give. I'm sure we
 don't have to do this. During the ~~centuries~~ a mechanism has been evolved to make it possible
 for devoted scientists to do just that, to live in guilt and to produce results./ Only people
 who have not accepted this idea are the scientists themselves. Society as a whole, and
 especially the leaders of society and the public spirited people of/society have a much
 deeper understanding of this ~~xxxxxx~~^{our} than we have ourselves.. It is for that reason that
 universities have grown up to play the part in our ~~xxxxxx~~^{civilization} that they have. The mechanism
 whereby this is done is very complicated and I think we ~~xxxxx~~^{should} not dissect it; if we do we might
 be disappointed. There is a deep feeling in these people that something will come out of it,
 not necessarily out of the individual/ workers; work, not necessarily perhaps even out of
 the individual small institution, but the statistical results, the over all results in the
 long run will pay off. The University ~~xxxx~~^{is the} mechanism that has shown itself to be most suitable
 for getting support for useless things. I think this will continue if we just keep on with
 the things that we want to do and not worry about where the money comes from. I'm sure we'll
 get it. If you go out and take from industry and from agencies of various
 kinds for specific purposes merely because you are good men who are willing to work cheap,
 I think you are making a big mistake. I'm sure these same agencies can find other ways of
 doing the same job and it must be done. It will cost very much more
 some other place

Chairman Thank you very much Charlie. I'm sure everyone appreciates that, it's a great keynote/
 beginning this conference which in many respects it is supposed to be
 and I know we are all happy that we have the equivalent here of what Hugh Miller said that
 Socrates had, namely Plato/. Plato is reputed to have recorded the things that
 Socrates said

But without further *Chairman* we will now ask for Mr.
present and the future.

Mr. Chairman, I'd like to say first that I feel I have very little to contribute. I feel personally that I have gotten a great deal from coming down here and enjoying your hospitality. I've learned a lot about oceanography and about the Scripps Institution that I didn't know before. Actually I think in the long run that it is a good thing to have as many people as possible know what you're doing and how you're trying to do it. I feel that many of the things that have been said have been said so well that there's nothing I can add. I have been thinking about many of the questions that have been talked about and I've been thinking about them in terms of what specifically I might be able to do about them. One or two of these are in connection with the problem of getting people interested in oceanography, the various aspects of it and specifically in connection with the question of why biologists are not interested in the biological aspect of oceanography. I know that one of the benefits that I have derived from being here the last two days is the appreciation of what some of these problems are. I suspect that in the future I'll be in a much better position to discuss with someone who might conceivably be interested in some of these problems. I might be able to discuss these a good deal more intelligently than I could have had I not come here. And I suspect that is true of all of us who are not directly connected with oceanography, and I feel that in the broad sense this is something that is a very useful thing to accomplish. One of the other things that I thought a good deal about is what Dr. Rakestraw raised in his discussion, the training of future people in the field of oceanography, graduate students in particular. He has indicated and I know all of the people here realize that you have a rather special problem here because of the fact that you are a rather specialized institution with many of the fields science, of
of/physical oceanography not represented here. I don't know how the problem of broad training of graduate students can be solved here. Maybe it can be solved in a rather simple way. It certainly is a problem that exists in every institution, in every branch of science and it's a problem to ~~xxx~~ which there are many kinds of solutions. It has occurred to me that possibly you're more aware of the difficulties than some of the rest of us are. Therefore because of your conscious interest in this problem, you may actually do a better job in seeing that your students receive broad training than some of the rest of us who take it for granted that because they're in a place where the opportunity exists to get broad training they will in fact

get it. I don't know what you do about having students get initial training in mathematics, physics or chemistry that they might need here. And I'm sorry to say that I have no suggestions about how this problem could be solved. If there is any way that you can solve it. Perhaps you can't. But it seems to me that this is a problem that requires good and careful consideration. I was very strongly impressed by the remark that Dr. O'Brien made last night. Perhaps the best way to train people in oceanography is to train them in something else first. And in thinking about this I realized that in modern biology many of the advances at the present time are being made by people who are doing it the orthodox way at all. For example we have in our group several physicists who were trained in theoretical or experimental physics and they have ideas that I'm sure conventional biologists would not have. And perhaps you're in a position here where it is necessary that you take people who are trained in other disciplines and then develop in them a ^{While} and interest in oceanography. These thoughts are not new or particularly valuable, I would like to say finally that personally I feel that I have had a very liberal education the last two days and I want to thank you for helping me to get it.

Chairman Are you willing to give us some of your wisdom on this now Dr. Bronk? Are there some final thoughts here that you would like to leave with us?

Bronk I certainly have no solution. I would if I could but I cannot. There are certain opportunities that you haven't, you haven't spoken of Johns Hopkins University. I think there is much that one can learn from what has happened to that Institution. brief history of it as ~~xxxxxxxxxxxx~~ a noble experiment, and it ceased to be that when it proceeded to do what other institutions did, because I assume it is easier to do what others do. Doing what others do is the easiest thing to do and this I think is a tragedy of American higher education. Institutions feel that they must or do by desire follow a fairly standard pattern. I think that one of the basic difficulties of higher education, speaking as a person who has had no experience in education whatsoever, is that it is assumed that a university is a place where people are taught. And this I think is basically wrong. It seems to me that if one follows the high sentiments that Charles ^{has} expressed a few moments ago, recognizing universities as homes for scholars. And if the scholars, this is an extraordinary opportunity in which young men can learn not taught, speaking in the conventional sense. So a place like the Scripps Institution

Blank

rich opportunity for studying within the framework of a large university, the example of a community of scholars, working on what they want to work on, doing what they wish to do, and receiving young associates who have the opportunity to learn by association with these more mature scholars, in an atmosphere of freedom. The term freedom has been used so much in recent weeks, and months, and years that I fear it begins to lose its significance. I am sometimes afraid that we will forget the power of freedom just as we speak so much of democracy that few people stop to think what democracy means. Both freedom and democracy are words that are strong words that have simple meanings but broad implications. I think that freedom is the very basis for all things that have been really significant in the achievements of scholars. We can argue a great deal as to the relative values of basic and applied research, of contract and uncommitted research but these decisions are insignificant and meaningless if we give to the people who do whatever type of work they are doing the freedom to proceed as they themselves think they can best proceed. I realize full well that there come times in all research when

unrealistic if we were to sit back and say that we will never apply science to the satisfaction of specific needs. But even there I think that one has the greatest achievement when as I said last night, individuals are organized ~~by~~ only by choosing those individuals who wish to do only that which it is desired to have done. I realize that none of us are completely free agents and because there is a growing restriction on freedom of action, I think it is very essential that more institutions, universities to be specific, shall do everything within their power to preserve freedom for individual action, freedom for thought, freedom for ~~debate~~ debate and discussion, with due regard for the rights and opinions of others. I think this is a subject to which we must give much thought in these times. I have heard it said over and over again that what the various scientific organizations of this country must do now is to organize science more effectively, that we must do this and we must do that. We must have more action in all branches. I think that more action is desperately needed in these times. I think what is necessary to remember is that thought should ~~precede~~ precede action, less action lead to confusion. And this I am afraid is the root of so much of the confusion of national objectives, of our national strategy, of our national . This is something that universities and institutions such as this especially, which is less encumbered by over organization, can contribute to the country and its civilization at this time.

Brown

If there was ever a time when we needed thought it is certainly now. The more complex the issues is the greater need for thought, and greater is the need for breadth of understanding, for breadth of training. Only then do I feel that action will be significant and beneficial. So in an institution such as this I say again I think your greatest contribution to the national welfare and to the furtherance of the higher objectives of civilization is not primarily what you discover, the very best way to can sardines ^{to} which we have often referred in these two days, not only what we discover with regards to salinity of the sea, movements, currents, and new mountain ranges at the bottom of the sea. These are important and the main reason why they are important is because we have given ~~x~~ freedom to individuals for intellectual exploration and their discoveries move more people than we realize. What you really contribute which is most important is the example you set ^{of} ~~xxx~~ thought preceding action and an example of the power of freedom of individual thought and action.

Chairman Mr. Redfield, do you wish to continue at this point?

Redfield I'm sure that various guests who have been brought here from other parts of the world stand with great humility and just pride before you which I'm sure there will always be expressed great appreciation, and I think that in the course of the past 24 hours we have arrived at a discovery of oceanography ^{as} ~~xxx~~ being a very specialized subject. It seems to me that this discussion has proved just from the first that it's a most unspecialized subject in which disciples of everything from shall I say the fisheries to philosophy can ~~x~~ join together in very genuine and honest discussion. I suspect that the problem before the University of Calif. in developing this Institution is partly to keep oceanography from becoming a specialized subject because it should remain a special subject but not a specialized one. I hope the pattern of oceanographic training and development will not become congealed as it has in many of the older disciplines. I think the whole stigma of the subject is in its, if you will excuse the pun, fluid state. By specialization in a subject I am thinking of the lamentable state in such honorable disciplines as chemistry and physics. I speak with feeling because my son graduated a year ago with at least minor honors from Harvard University where he has specialized in physics. I have no doubt that he obtained an admirable training in that specialty. He had a very complete roster of courses in mathematics and the various specialties of physics, only by the minimum of snap courses in social or liberalizing subjects. Here is

M. Redfield

a young man who certainly has some prospects for future contributions. He knew nothing about the process of physical chemistry to take the smallest step, of biology, of social implications of all these things. And I think that that was unfortunate although perhaps necessary in developing the specialty of physics to the highest in certain directions. I think that this applies equally if not more so to the somewhat more ancient discipline of chemistry where the catalogue of every college repeats almost to exactness the catalogue of another college. I feel that that is the wrong direction although it is perhaps the direction in which we will inevitably go.

touch upon the training of graduate students and the education problems that come in providing the broad ~~xxxxxxx~~ and special knowledge.

Professor Miller in that in his suggestion that to a certain extent it may be better to carry oceanography into the universities rather than carry the universities to the ocean. I have thought very seriously about the still more intangible problem that we have at Woods Hole ~~xxxxx~~ in this connection where our university relationships are somewhat less tenuous, where we suffer very much from the problem of students for subjects. And I have sometimes speculated with the idea of whether oceanography might not actually be setting a somewhat new pattern in the educational scheme, that perhaps it was a subject which would in general force be effectively developed if it became an inter-university discipline rather than an intra-university discipline. Whether we should not in the training of the student or the scholar in oceanography attempt to a much larger degree than commonly has been in education to encourage the migration of students from institution to institution as I understand has been much more the practice in European educational systems than in us. I question / whether every oceanographer who pays much efficiency should not become versely acquainted with the shores of more than one ocean. I question whether most universities, certainly most private universities, who are not very happily and specially endowed, could actually afford to set up expensive and adequate and broad training programs in oceanography, but whether it is not necessary for the various universities to specialize or limit themselves more or less to certain aspects of the subject but to provide a possible means ~~■~~ for the student to supplement the deficiency of his home base by periods of study in other places. Now finally I'd like to give just a word about my ~~xxx~~ bedtime ~~xxxxxxxxxxxx~~ contemplations? on the questions which we discussed last night and which I am somewhat ~~un~~happy to see have been erased from the board. I'd like to call again a source

Redfield

of during breakfast with Professor Miller who suggested to me what was perhaps obvious but to me an idea which is somewhat unfamiliar, that progress in the physical sciences is going to come by the absorption of concepts from biological sciences. You see the biologists have been trying just as hard they could for the last generation at least to reduce all biology into physics and chemistry and mathematics. That has been the . and here is a suggestion that we go the other way and somehow apply the special concepts that you get from studying the complex biological world to the analysis of the physical and chemical systems. And that is a perfectly sound one and I found and almost saw that I had started on those steps because my approach to oceanography has followed an earlier career in physiology, and to me in a sense the ocean is an organism. It has a respiration, a metabolism, it has a composition heterogeneous ~~composition~~, it has many of the properties of organisms and I have quite consciously been working back in that direction although obviously I have not gotten very far. Now taking that thought, what were we talking about last night? It seems to me that the question that we were really discussing or should have been discussing was this. Do you have in an institution such as this a stable aggregation of individuals each with perhaps a quite distinct background in one of the conventional disciplines within the range which we are discussing, physics and chemistry and so on? Do you have in an institution such as this a really stable aggregation which is working in what the ecologists would call a somewhat relationship? That I think is the real question. Does such an aggregate of talent as represented by the present or future staff of the Scripps Institution represent some sort of a natural community of interests? It seems to me that it does and I think that the whole question of what the program should be, whether the place is justified or not, merely comes down to the question of whether in reality this is a mutually stimulating productive and coherent group of people. I try to remember the you suggested I got off this morning, because I recall Well that was the point I was trying to suggest, that this is sort of an organism, that this is sort of a niche. It seems to fit together, at least at this stage of human culture in a permanent way and that is worth preserving. I think that the example that I drew was that if we could quite conceive of the University of Calif. as bringing wisdom, concentrating here on the shore a group of chemical oceanographers and a group of theologians. Now I don't believe

Redfield

that that would bring forth a stable organization at this particular stage of the development of learning that we are talking about. They would no doubt walk straight together on Easter morning, they might have bull sessions in the evening but I doubt if they would be working together but I think there's no question that the mathematicians, the physicists, chemists, biologists are working together here. And I don't think you can say very much more with regard to future development but that you should have that in mind that the staff should be supplemented in so far as you see opportunity to create the stability, the coherence of the group and you can't say very much more about that until you begin talking about how many thousands of dollars and what particular fellow you most need, and all that, and that is too subtle a subject, too delicate of one to discuss in a meeting of this sort.

Chairman Iselin, do you have anything to add from the ~~xx~~ store of knowledge that you have from your Woods Hole experience and how it developed?

Iselin Well, I have only a few thoughts which I'm afraid will bring the discussion to a very much lower level. I think first of all it is fair to say that we have been doing a fairly good job in oceanography, especially here at La Jolla, otherwise we wouldn't all be here. Our formula, I've been told, which is not fixed but has worked more or less, for the last ten years at least. It has been reasonable in a small research organization that about half the time people are willing to work for a living and the other half they should be free to do what they want. And we find at Woods Hole that the younger people are perfectly happy with this work.. That about ~~not~~ day by day or year by year or over the course of the years. But about half of the time ~~xxxx~~ an individual is working on one of these contracts and about half of the time he is doing whatever he wants to do. People differ in this respect. Some people prefer to work on contract work, others don't like it. But if we find that we can finance the thing on the average about half of our ~~xxxx~~ ^{effort} is on contract work and half of our effort is on pure science. The other people I think at least feel that this is a bargain even in universities, ^(ic) You've got to do some work, you've got to teach. At Woods Hole we have men consciously in the business of bribing the universities to take in some of our people. We've been in the business of bribing the universities to add people to their faculties that have some understanding of oceanography. I think that we're going to have to go on doing this but possibly as time goes on if we do a good job in our research program we'll be bribing the universities less and

Iselin

less or shifting universities and bribing other universities. You can't bribe them all but you'd be surprised how many universities we are actually bribing at the present time. And we lose to considerable degree some of this contract money to bribe the universities to accept some ~~xxx~~ of our people and allow them to give a course. We have ~~xxx~~ found it somewhat difficult at Woods Hole I think to find young people capable of doing creative research and they simply turn up from time to time. The problem is to spot these people and to enable them to grow and to develop naturally. My successor at Woods Hole, who is a great deal more technical scientist than I am, never went to college and we found him struggling in the days when the government was bribing artists. He was doing a mural in a near by post office. But he is a man today and only 12 or 14 years have gone by who is doing some of the pioneer thinking in the problem of the circulation of the ocean. He is perhaps the most ^{formal} man that we have in the whole institution. His only/education was two years in fruit growing at a small agricultural college. I think these people, these really good people, will turn up no matter what you do and the problem is to allow them to develop. If one can help them gain a broad liberal education, if one can arrange for them to go to good lectures, to read good books and so on. But it would be very foolish to deliberately try to educate them. They're much smarter than we are. One can't manufacture such people, but if you have the right sort of a fly paper they'll come and stay there. And I think the problem is only to try to develop ^{that} the right sort of environment, ~~xxx~~ the great people will come to ~~xx~~ it, and you've done a very good job and I would continue to concentrate on just that.

Chairman Several of us who have discussed this meeting this morning at breakfast, had the feeling that this ~~xxxxxxxx~~ session at any rate should be free from restraints of the usual sort, that we shouldn't think of our program particularly in terms of budget, particularly in terms of our clients ~~xxxxxxxx~~ and yet we can't lose sight today of the obligation that we have to our country that has been pressed upon and we have not heard from Captain Cutler who does represent the armed services here and is the director of the NEL and I think it would be appropriate to hear from him in this context. We are not emphasizing, I want you to understand, any particular client, but ^{Roger} ~~Ex.~~ Davidson figures ^{support} that comes to the Institution from the University, from the State, which comes from other sources, and which comes from the Federal Government primarily for national defense. And whether we want to or not we can't escape this obligation which we have at the present time if we

are going to survive the way the country survives we know we must at this time give thought to that part of our profession. And certainly it is going to have an influence on the immediate shape of things at the Scripps Institution and therefore I think it would be appropriate to hear from Captain Cutler.

Chairman
Capt. Cutler Thank you Mr. Chairman. I think I would like to speak more as a naval officer rather than as the director of the Navy Electronics Laboratory. I'd just like to remind you that our principal purpose in life is to assure the freedom of the ocean. So I certainly, at least, feel at home in this gathering. For after all we are gathering scholars in many cases who are trying to find out something more about the medium in which we operate. I think that in itself is sufficient reason for the Navy's support of oceanography. A great deal has been said about contract research, I suppose I might represent the sordid side of the house, but I don't regard it in that light. The main concern of the contract type of research I think is the fear that the program may become one-sided or unbalanced, or we might even introduce that hard word of military regimentation into the picture. I think those who have worked with the Navy have very little fear of that. There is no use asking a man to do a job in which he is better qualified than you are and then telling him how to do it. So that is not our philosophy. Others have been concerned about the effect of the emergency on the oceanographic program. In particular, perhaps, on the scientific program in general. I think from the scientific end the most that can be said about the effect of the emergency is that we have a chance to get a little more financial support but I want to point out that there is very little you can do about the present emergency in the scientific field because scientific research is of course the melting pot? and chronologically is the first thing in the process which contributes years later to the greater effectiveness of our fighting services. So we have to in the Navy take a rather long view of scientific effort and, we regret actually very much that there is a contraction and expansion in our support of the program ~~xxxx~~ due to the ^{If} appropriations. /We try to smooth that out and provide a long range program we find it very hard to allow us to ^{our} money over a long period. In other words the money we get this year can be spread over at least three years. That helps to take up the slack, or rather people know the situation. It has been said that the only justifiable way to control research in any way is to perhaps pick the man who is interested in doing the work that you want done. I think that is pretty much the services' viewpoint

Cutler

although we are pretty hesitant about saying sometimes exactly what work should be done. I think at worst perhaps from your view point our attitude might be summed up something like the story of the Scotsman who told his son, I wouldn't for a moment suggest that you marry for money but I hope that you will always go around with rich girls. We hope that you will go around in finding things that are of interest to us. In conclusion I would like to say as an old conference sitter after 9 years in Washington that this is one of the most pleasant that I have attended. The well known California hospitality has certainly lived up to its best reputation. Thank you.

Chairman

Now we have to come to ~~x~~ with some of these practical problems that Roger has posed. We've put them in writing here on the board, at least they shouldn't be erased yet. Before we do that I know that some of our guests have to leave now and we bid good bye to and and thank them for their contributions. Professor also if you're not leaving, I hope not. Many others have to leave at eleven but ~~ix~~ may I in just 30 seconds or so name a few words which it seems to me have come out and then probably Mr. Schlichter will speak about one institution of which we hear a great deal which is so intimately related with this and which is university-wide in scope, the Institute of Geophysics. But some of the important things it seems to me that give us background and especially the things that have been said this morning, that good men must be at institutions, that stands before all else. We must not confuse bigness or physical plant or organization or operation ~~xxx~~ by conventions and committees and things of that sort with the operations of good men. They must be more than a group, they must be a living, organic, dynamic thing. That has been quite definitely made clear to us. In dealing with a problem as difficult, as complex, as unknown, as unpredictable as the ocean, man must have physical facilities with which to work. Those of us who worked through World War I know how seriously we were handicapped because we didn't have submarines, we didn't have surface ships, we didn't have the facilities with which to do the work. That was one of our greatest handicaps. In terms of the emergency it is often said that at the beginning of World War II we had a plentitude of physical principles which were ^{or not} just ready for commission, ready for exploitation into ~~xxx~~ radar, into sonar in our own group here, into the atomic bomb and the proximity , and many physicists that I have listened to lately regret that we have today quite a reverse situation. We had these ideas then but we didn't have the laboratory facilities, we did not have the staff to work on these

Chairman

problems. They say the thing is turned around the other way now and that we have a of these physical principles and ideas which are ready for exploitation into at least military application and that we have on the other hand a plentitude of staff and laboratory equipment and so on. Some of those things we do have now. We have support. The Navy for example is willing to support these projects to an extent which will be determined not by the size of the appropriations but rather by the physical facilities and the manpower that we can get to do the job. Certainly the work ~~h~~ that is to be done during the emergency must utilize every resource that we have and if we can fortunately for some time in those problems think more of limitations in terms of manpower and equipment available rather than the money for providing those things. At least in part of our discussion today we can be free ~~fr~~ of the ever troublesome problem of how ~~xxxxixix~~ much it is going to cost. But let us now turn to Dr. Schlichter who can give us one of the examples of an organization of a university and in the remaining time I think we ought to try to address ourselves to the practical problem of any help we can give these good people here in the actual organization, the extension of the organization that they have now in such a way that it will be most fruitful.

Schlichter Mr. Chairman, Columbus Iselin's remarks about his so-called uneducated director reminds me of the story of the educator who toured the south and who had a very pleasant stay. He talked at the railroad station with an ancient darky, a wise old darky, prior to the Civil War days, slave days, who numbered 16 known grandchildren. He talked about the problem of education as he saw it in his own , in his own experience. And he wound up with this remark "Without an education, boy you sure got to use you head". What seems to me a rather nice example of the four-fold integration of geophysical work, right here deals with the broad Pacific. One of the great chunks of the unknown is the meteorological aspects of the broad Pacific. Columbus Iselin also mentioned the other day the need of between the relationship between dynamic oceanography and meteorology. There's been a project at the Institute of Geophysics for the last four years which has dealt with of meteorology. There the field is almost untouched. There is the advantage of a great density of observational data which has arisen from ~~xxxxxxxxxxxx~~ operations possible through work with the Navy and the Army. The amazing amount of meteorological evidence. This is also a nice broad sea level surface and it's free from the forces

Schlichter

the exceleration which complicate meteorology. So this is an ideal spot for research and basic meteorology. Now from this research

Not only that but the bottom conditions, the deposition of sediments, the Patterson expedition have been explained in terms of this change in the oceanographic current.

earlier predicted before Patterson even began to worry about the change in these cores, Patterson's

Not only that but there seems to be a certain stability about this arrangement. The thing seems to go back to paleo- _____tology, the _____ of the _____ Islands are still existing _____ to the north and south

This is rather a clean cut little example of the ~~close~~ close tie which exists between all the branches of geophysics. Now the purpose of this organization, the Institute of Geophysics, is to promote the tie, the natural tie, which exists between all branches and also all units of the university. The Institute of Geophysics like Scripps is primarily a research organization. It's purpose is to promote interest and research in the broad fields of geophysics and also _____ the university. I might add that this bit of research that I've just mentioned is a contract supported research. It was evolved by the research men, originated by them, and merely supported by the ONR. And I think that is really the key to success in ONR in contract supported research. Those researches which are natural have the enthusiasm and the drive of the research person. When you go first you get the draw on this ONR, you say here's the kind of research we wish to do, will you support it. I think the answer is almost always yes and you get it supported the way that you wish it supported. We've had very very fine experience in not only the Air Force research program, but the ONR research program. But to get back to the subject the Institute of Geophysics has this primary purpose of encouraging, promoting and to some degree integrating research results in the broad field of geophysics. It is a very young infant, it's four years old, it has in fact the same size staff that Scripps had during the days of _____ from 1930 to 1937. We have a very ~~small~~ small staff of 36 people, organized in a sort of a unit basis, _____ x five small groups, _____ without growing pains, we have the natural units of research, a research worker with a ~~small~~ small group of graduate students. The individual is really always the key to research. Now since the most fertile, the largest and the most eminent research group in geophysics in the University of Calif. is Scripps it is natural that the chief interest of

the Institute of Geophysics is to give such assistance so that it can ~~xxx~~ bring to bear upon the work at Scripps. Scripps is the most _____ unit in the university in the field of geophysics, the ~~the~~ Institute of Geophysics, in its attempt to cover the broad field at the university, turns its eyes most frequently to Scripps and looks in the future to the greatest amount of progress that Scripps is making in its fundamental approach to geophysics. There is no shoreline in geophysics. The oceans and the land from the point of view of geophysics of course in exploration are/the same part of the globe.

Revelle Dr. _____ was called to the telephone. I'll take over in his absence. I think you have struck a key note in your last sentence Louis and I would like to hear said in the next half hour or so that ~~there are no boundaries in geophysics,~~ shoreline. Actually we have spoken of the unity of the oceans. It is true also that there is a unity of science and it is very hard to find any boundaries and this of course is the real meaning of the university. The university _____ and encompasses the universe of knowledge. Many of the speakers have pointed out how fortunate we are to be part of the university. This was probably one of the main reasons in the back of their mind why they said that. The question seems to be at the present/ time is to look at the future and see how over 20 or 30 years this Institution can be/^a more effective and valuable part of the university on one hand and on the other how we may take advantage of the great meaning of the University of California. It's certainly a unique institution in the world. The University of California is often thought of primarily as the biggest university, or one of the biggest universities in the world. This seems to me to be most unfortunate as an outstanding characteristic of the university. Actually that is I think our chief handicap. But we not only have handicaps in the university, we also have great values in this university. Alfred _____ was saying one night in Washington that California is in some sense a nation and this of course is

We out here think of ourselves as a nation. _____ in the United States have had a continental development which is perhaps one of the main reasons for our present imperial and somewhat intellectual preeminence among the nations. Likewise in California we have in the University of California a nation-wide university, a university because of its many campuses has incredible scope, has ~~flexibility for~~ possibility for flexibility in experimentation, for practicing pioneering without taking too great a risk in new kinds of

Revelle

scholarship and in new ways of applying reason and careful inquiry into the problems of mankind. And it may very well be that here in La Jolla we can do more, I'm not sure that this is desirable or possible but at least it's worth talking about, is we can do more to help the University of California to develop new ways of applying reason and inquiry to the problems of mankind. I'm particularly interested to hear /whether any of you from the Los Angeles campus of the university feel just this way about it and also, how you think we can go ahead in this direction. Perhaps Professor Miller would care to speak on this subject.

Miller Thank you Roger.

aware of La Jolla as the place where sometimes it is possible to go and get a in the summertime . We have become increasingly aware of them. I think it has been shown especially by Louis Schlichter how valuable this contact is. I think if we will develop naturally we will integration which means that part of the field of knowledge and part of the institution of knowledge will integrate and balance together. I confess I see no problems in the way of the development of Scripps. The one problem is the continual one, that is insuring the financial means of the future. That means that you can develop a program with the assurance of continuity. And that the assets that you have here at Scripps, and the University of California, and all of the universities of the United States, that is all you need. I think you need a small and assured, not too small, ~~xxxx~~ continuous budget, so that you can bring the people that you find here with the assurance of permanence, assurance of continuity of the enterprise. That seems to me to be the practical consideration. And I think that the are here and you can't formulate that, you ~~shouldn't~~ shouldn't formulate that, that will change as the years go by and the biology, and physics, and geophysics, and astronomy and all of these sciences will create new problems and new lines of ~~xxxxxx~~ advance.

Thank you. We haven't heard from Putnam here.

I'm going to speak very briefly to the point of the future of the campus at La Jolla in perhaps the aspect of its relationship to geology. encompass the whole field of the relationships of geology and oceanography. They are very close both sciences are addressed to one of the most unique features with which we are confronted in science, that is the earth in its infinite variety . Geology has profited

Malin

enormously from oceanographic research, after all the sea has a bottom as well as a top, the bottom is primarily geology. Clearing away the prejudices that have survived from the past within the last few centuries have been the result of oceanographic research, in itself would be a topic that we could devote at least a day's consideration. But to summarize as briefly as possible the field of geology, one of which the main emphasis has been primarily you might say the remembrance of things past. We deal primarily with the record

of events that occurred in former times. If we keep that point of view perhaps in mind for the main strength of geology it seems to me that here we're confronted in the ocean, or in the ocean we are confronted with the here and now, and one of the chief tenets? to which we hold in geology is the presence of past. If the assumption is correct it seems to me if we are to read the past we need to know much more about what goes on in the world today, and there we are confronted with it outside of these windows. So I could give just a small suggestion of what would appeal to me as a field which Scripps Institution as it develops more, opportunities it has to develop great strength, is the dynamical approach to the physical world. We need to know far more than we know today about the of sedimentary rock, what they tell us in the past.

Geology as it's true of oceanography has a biological as well as a physical side. And it's quite interesting to see the way in which geologists circles, will take fossils, to them we can all kinds of virtues, or lack of them, say that they reflect temperatures of this sort, environment such and such, then on that base we can say that the rocks accumulated in such and such a condition because the fossils tell us that it is so. And having set up an environment

. So I hope that we can get great strength from the Scripps Institution if we can work out this controlled? relationship and we're sure we can learn something of fossils something of the rates of change, something of the way in which things take place. That will help us greatly in our endeavor to read the story of the past.

Chairman ?Dan, I wonder if you have remarks to make pertinent to this association between U.C.L.A. and *Dan?*

. I don't think I have anything to add to what has already been said about the broad aspects of oceanography but I would like to make a few remarks about the phases problems in marine biology. I believe there are some ~~things~~ in marine biology which can be studied to much greater advantages here than on our other campuses. On the other hand there are

Lam?

some phases which I believe could be studied to greater advantage on other campuses, particularly Los Angeles, and I see no reason why we can't develop marine biology on both campuses interchanging students, and cooperating as far as possible. We have the same problems with other fields on other campuses. Recently our own department has worked up a plan by which we exchange not only students but teaching assistants with the department at Berkeley because they are obviously better than we are in some fields and we think we are better than they are in other fields, so that we want to shift our students back and forth. We have very excellent cooperation at present in sending some of our students to La Jolla for ichtheology, and I don't see why that can't be extended to other fields.

Paul)-- I should like very much to say one thing that does not bear directly on the question of oceanography, nevertheless it does bear on the relation of La Jolla to the university. I was very much struck yesterday morning at Roger's appeal ~~that~~ that the university is a means of preserving the freedom of scholarship. I like to believe that perhaps he had in the back of his mind not just the university in the abstract but this particular university and the way that it is organized because we do have in this university a unique or at any rate a very considerable measure of faculty self-government whereby the faculty is able to direct to a considerable extent what it conceives to be the proper conduct of the university and in that connection I want very briefly to mention a report that was made by the Academic Council recently to the southern section of the Senate. For the benefit of those who do not know I might say that the Academic Council is an ~~ix~~ all-university committee, a coordinating committee for the purpose of directing to various standing committees discussion of questions that have ~~xxx~~ all university bearing. Now the university at the present time stands in some danger I believe of losing that unity which is implied by the name. In the past the unity has been maintained to a very considerable extent through an administrative means. Now it appears as though there will ~~x~~ be a much greater autonomy on the various campuses.

it that is highly desirable because the university has grown to such an extent that to have complete centralization of administration has proven to be difficult. How then may we retain and maintain this unity we believe is essential? The recommendation that the Council made is very simple, namely that each campus should through the committees of the academic Senate cooperate much more closely than it has done in the past, working closely with the , ~~x~~ and I wish therefore to appeal to Scripps to help to maintain that

unity of the university by service on our committees to the greatest extent possible, although I realize that the distance makes that difficult. Nevertheless I believe there is a genuine desire to do that and I believe that the more our several campuses can cooperate at that level and in that way, the more certain we are of preserving the unity and that freedom of action that Roger referred to.

Lee⁷, ^{Chairman}, have you anything to add?

I'm sure that anything of mine will be of a much lower order than has been offered by those who have been speaking so far. I _____ in the University of California have almost become a California _____, and I have regretted somewhat that since the depression California has become part of the union. There is within the University of California, there are within the University of Calif., a series of problems that need to be solved. I think that many of my colleagues have imparted these problems. The proposal that I have made continuously is that there must be a consideration of ~~RECENTLY~~ ^{autonomy} of organization, but I do not conceive of this autonomy as necessarily being a geographical one but rather one related to bodies of knowledge, to men working in various common interests. And that of course needs to be pointed that our colleagues on the La Jolla campus have ~~been~~ ^{the} wonderful opportunity to show the university a way in which ~~an~~ an organization can build itself around a common body of knowledge. It has already been implied by any number of speakers that the search for truth is in effect an analytical experience, an/ experience in analysis, and that this search is likely to cause segregation of bodies of knowledge, largely because of the segregation of individuals who are working within these various bodies of knowledge. Oceanography, among others such as agriculture and possibly such as engineering is in effect a synthesis of all knowledge and for that reason I treasure the work that is being done here, that is being contemplated here, because I believe that a group such as the group at La Jolla, not being geographically related to the other campuses have an opportunity to work out a mechanism, organization and relationship with the rest of the university which will serve as a guide post for those of us who are on the major campuses as well. That engineering twice in its history has made the decision to remain on a major campus, twice, once when the University of Calif. was founded and it was decided to merge the College of California, a private sectarian institution with an institution which could have become an A&M institution of California. The two

merged and became the University of California. Again, only within the last 8 years, it was decided to establish engineering on another of the larger campuses, so that we have this one example of one major body of knowledge being treated on an individual campus. And I therefore look forward to working with the group at La Jolla and with the several groups on the several campuses in developing an organizational structure which will yield the proper level of autonomy which will allow all of us to take advantage of the whole university as a vibrating organism and at the same time to completely obviate all of the difficulties that arise in working within a very large organization in which there is a tendency for everyone to think that his business is everybody else's business and . I think that all of these comments have been made, some and some directly and present group for consideration by the group here.

Chairman Thank you. Perhaps the person who has had the longest experience in one of the largest councils who has not yet been heard from, Professor Stollard? of the Berkeley institution, which is certainly our parent.

Stollard I'm much amazed by that remark. I think most everything has been extraordinarily well said. I should like to say to the younger people here that I think you've been exposed to a most unusual conference, especially last night and this morning. The of academic philosophy which were reached that are rarely reached, having suffered through many summer sessions, and having had some experience through the years with the master-minding that goes on in the foundations and the research councils and so on, I've been greatly heartened by the advice that you have been getting from your older statesmen. It seems to me there has been talk here of the university, in the old and primitive sense. When you're told that you are such or should be such, that you form free associations of scholars, that you direct yourselves toward the things that your minds best bend and in which they best meet and that you should

these associations as you find it desirable to do so. I really ~~am~~ have been moved by some of the things that have been said here by people who have to administration and we professors don't ordinarily expect this growth in wisdom and in grace. I suspect that the crisis for this Institute, if there will be a crisis, lies ahead. I think that your history has been extraordinarily fortunate and your present is extraordinarily fortunate. I was interested that remarks came up concerning the, what I should call the hazards in mind reading. There wasn't too much time spent on that but I think it was a significant

discussion, that maybe you are better off as long as you are people who need to study oceanography and spend your lives together, than you will be if you develop a second and third generation of oceanographers who have been raised at your own hands. Now that's a problem which you have before you. Now I would like to bring up ^{briefly} one matter. I've been trying to think where I might possibly classify myself and I've decided that if I must call myself something I shall call myself a piece of a historic. And what I'm ~~getting~~ ^{driving} at is this, you're dealing with a major part of a great invention. And you can contribute a lot that is in the unknown by developing historical perspectives in this direction. I'm think especially of some of the remarks that Carl Hubbs made yesterday afternoon. This ~~business~~ business of climate? we're getting a lot of additional knowledge on, especially on the land and this engine? has suffered fairly considerable modifications. We're becoming more and more aware of that. When we took this trip to the top of the mesa here we were kicking around iron concretions? that didn't form under any present climatic pattern. The shore distance off to the south in lower California you have a mandatory? desert at the present time. ^{With} Very stable air and extremely slight possibilities of ~~precipitation~~ precipitation. All down through there there is an abundant record ^{of} a time, a time, when there ~~is~~ ^{was} no desert there.

which simply involves climatic conditions which do not exist there at the present time. This refrigerated ~~was~~ was not refrigerated some time in the not too distant past or else those glaciers could not have come down the slopes to the sea. Now there's an awful lot that you ~~people~~ people on the sea side may work out as to differences in sea temperatures and differences in oceanic circulation and this was brought sharply to my mind by Hubbs' concern with shells as measures of sea temperatures. So what I think I am trying to say is with your concern and ~~capacity~~ capacity and preoccupation with experimental work, don't forget that you also have a very important job to do in history. There's a physical history ~~past and present~~ past and present involving ~~experimental~~ beyond the ~~experimental~~ experimental approach. So give a hand to these people who are working on ~~these~~ these very significant problems of historical physical change of the sea.

Chairman I believe we have heard now from the members of the university. We haven't much time but there are I know ~~xxx~~ other guests here who have words of ~~xxx~~ that they would like to leave with us.

especially

And once more Professor Hutchinson is there anything ~~that~~ that you would like to add here?

I don't think so.

spot to put me on in this stage of the proceedings. My apology the other night for speaking so badly . My apology would have been last night and is most certainly now that I have heard my seniors in earnest express far better than I ever could a great many things. We have been arguing about a whole series of things that seem to me to be matters of degree essentially. talked as we did last night as to whether we ought to discuss physical oceanography or biological oceanography. I think we came to the conclusion that the two are very close together now and that it is a matter of degree completely. I would think that ⁱⁿ the development of an institution like this that it doesn't matter ^{very much} which one you emphasize. What matters most is the people that you have in each of those fields. And inevitably one field will have in it at ~~x~~ one time men who will be much better than in the other field, and then will attract students of high quality from all over the country and perhaps from all over the world. And I wouldn't worry if that for the moment that were in physical oceanography because I'd be perfectly convinced that in a short while the boat would tip the other way and that biological oceanography would have its day. It seems to me the important thing would be to capitalize on whatever you have in which ever field it happens to fall. Let the chips fall where they may. I'm quite confident that the other side of the picture will shortly come as I say to balance the boat. We have talked a very ~~xxxxx~~ great deal about pure versus applied research and we've made it abundantly clear surely that this is nothing but a graded scale , and it's very hard actually to ~~fix~~ distinguish between what we call pure and what we call applied research. A person who is working on methods of canning salmon might be said to be doing an applied job but if that man was the right type of man plenty of pure pieces of science could come out of such an applied job. And similarly before the war I suppose an ichtheologist who happened to study the mechanisms by which fish made noises was certainly called a pure biologist. Now quite probably I think he'd be called an ~~an~~ applied biologist. No one then can predict ~~xxxxx~~ what research is in what we call in an arbitrary fashion pure science what researches will have practical applications. I'm reminded of a story that used to be told in the Medical School and I believe it's an accurate and authentic one. That is Dr. Ross Harrison's researches

in experimental embryology with amphibia embryos and larvae lead to a major development or revolutionary improvement in brain surgery. I don't suppose that anyone in the world could have predicted that that would occur. Nor do we know it seems to me how science advances most rapidly, whether it is by concerted effort toward the applied thing or aiming at some particular job that needs to be done or whether by the random results^{allowing} that come by/a free ~~inquiry~~ inquiring mind to go where it wants. That being so, the state of the world being what it is today, it seems to me we have to make very special efforts to provide proper provision for the free inquiring mind to go where it wants. To preserve then for the inquisitive mind the chance, the opportunity to think as it wants to let it work in random fashion. If in these hard times the world gets worse and things look more and more pessimistic for us this becomes harder and harder to do. It's harder for the administrator to pick the men who ought to be allowed to have their random thoughts to go where they want. It's harder to keep those men from being put on applied jobs and the latter point I think is particularly true because anyone with a proper conscience will inevitably in times of stress feel that he ought to go toward the applied jobs. It seems to me that the job of the ~~administrator in keeping some of those people free~~ administrator in keeping some of those people free and allowing them to do their own work is a tremendous load. I could close I suppose the point with emphasizing/something that W. H. wrote and delivered I think in 1946 in a Phi Beta Kappa oration at Harvard, in which he says, "Professors back from secret missions resume their proper _____ oditions, though/ some are _____ ; they might ~~xxx~~ they met some big wheels and do not let you forget it".

Chairman Thank You. I regret very much that both our _____ conditions and this very profitable and pleasant gathering has to terminate very soon in order to allow many of you to meet schedules. Before Roger makes the concluding summary remarks there are just two parting jots here I should like to add based on long experience and probably have not been emphasized as much as they should. This is a most appropriate time I think in the development of Scripps Institution in view of the new autonomy which has been granted the various units of the university to which _____ has referred, at least the Regents believe they have granted that autonomy. Some of us are a bit questionable about that but you I believe have more to say about the kind of house you shall build here and on the basis of the experience that we have had at Los Angeles I hope you will put some of these

which this unique campus can serve the university, the state and the nation. I will not attempt to summarize or ~~only~~ analyze what has been said. That it seems to me can only be done after we have had considerable time to think over the events of these past three days. It is obvious to all of us who live in La Jolla, however, that this conference has far exceeded our fondest hopes for it. That brings a statement of fact that has been repeatedly made to me by members of our staff during the last 3 days. I hope that those of you who have come from elsewhere do not feel that we have imposed on your time and energy. You will certainly not feel so if you know how much your being here has meant and will continue to mean to us. I do not believe that this conference should be a unique . We are so relatively isolated here at La Jolla that we need desperately a continued re-examination of our motives, our purposes and our problems by such statesmen and scientists, and scholars and yourselves. We propose therefore to give some permanence and continuity to this type of review of our affairs by establishing an Adviser's Council which will meet at regular but not burdensomely frequent periods. I hope we will be able to persuade some of you to serve on such a body. Let me close by once again thanking all ~~of you~~ for coming here from the bottom of my heart.

Certainly no more need be said except once more the gratefulness of all of us who have come here to witness the ^{and} ~~xxx~~ hospitality of ~~xxx~~ certainly one of the most charming hosts we have ever had the pleasure of meeting. I know that applies to me and I'm sure it applies to all the others who are here.