OCT 1974

SCIENCE BULLETIN

National Science Council
2 Canton Street
Taipei, Republic of China

Ship Model Basin Performing Duel Task

The Ship Model Basin of the Institute of Naval Architecture, National Taiwan University, built with the support of National Science Council, is the only one of its kind in the Republic of China. Since its establishment in 1972, the new outfit has been busy supporting both educational and research work.

SMB's major facilities include the following:

—A towing tank, measuring 74.5m long, 4m wide, and 2.4m deep, is complete with a carriage and related control systems. The maximum carriage as well as automatically. A flap-type wave generator is located at one end of the tank, capable of generating 0.3 to 3 cps frequency range regular as well as near irregular waves. A wave absorber is located at the other end of the tank.

—A set of balance type resistance dynamometer for measuring resistance, trim and heaving.

—A set of propeller dynamometer, capable of rotating up to 45 rps, for open water test meaurement of thrust and torque.

—A set of propeller dynamometer system for measurement of velocity and turbulence characteristics.

—Instruments for wave survey, wake survey, and photo-meaurement.

—Facilities for manufacturing ship models and propeller models, as well as other necessary drawing, measuring, recording and calculating instruments.

—A library of 33 ship related periodicals, 12 laboratory reports and 900 books.

Educational Function

To perform its educational task, the Institute provides graduate study programs for the degreee of master of science in naval architecture. It also provides Ship Modelling Laboratory programs for undergraduate students from Chung-Cheng Institute of Technology, Taiwan Provincial College of Marine and Oceanic Technology, and National Cheng-Kung University and a special ship design program for both students and naval architects working for the local shipbuilding industry.

Research Work

SMB's research workers are paying a great deal of attention to better fishing boat design because the fishing industry has been suffering heavy losses, averaing 50 boats lost at sea every year during the past five years. The Institute is pursuing a series of studies on various types of fishing boats such as 150 G.T., 300 G.T., and 1000 G.T., class trawlers. With the help of the Ship Model Basin, better designs suitable for the Taiwan area are being sought.

In cooperation with the local shipbuilding industry, studies on adding a bulbous bow or stern to 26, 700 DWT and 27,800 DWT bulk carriers are being undertaken. Also in progress are studies on the stability characteristics of 25 G.T. cement fishing boats, the resistance and planing characteristics of 36 ft. planing hull form, the design of suitable propeller for 150 G.T. tug boats, and the analysis of longitudinal strength of supertankers.

Other activities include ship--model correlation study, wake survey on 27,800 DWT bulk carriers for different trim conditions, ship grain loading studies, and ship subdivision study, etc.

Taipei to Host '74 Joint Staff Meeting of NSC and NSF

The National Science Council of the Republic of China and the National Science Foundation of the United States, executive agencies of the ROC-US Cooperative Science Program, will hold a three-day joint staff conference in Taipei on October 1-3.

Attendess of the conference will review the work carried out under the bilateral program during the past five and a half years and spell out a working plan for the coming year. Up for discussion will be the renewal of the cooperative program after its expiration next year.

A five-member American delegation will come to Taipei for the conference. They are Dr. Bodo Bartocha, head of NSF's Office of International Programs, Dr. J. E. O'Connell, program manager, Dr. Jackson Yang, program associate, Dr. Manfred Cziesla, head of NSF's Tokyo Office, and Dr. Peter Ashby, the deputy head of the office.

The Chinese delegation of eight will be headed by Dr. Shu Shien-siu, chairman of NSC. Other delegates are:Prol. Ming Che Chang, NSC Vice-chairman; Dr. Thomas S. C. Wang, director, Life Science, NSC, Dr. Erh-kang Lin, director, Natural Sciences, NSC, Dr. Chia-hou Cheng, director, Engineering Sciences, NSC, Mr. Wang Chi-wu, director, International Programs, NSC; Mr. H. C. Pan, cience counselor, Chinese Embassy/ Washington; and Mr. Charles W. C. Li, asst, program director, DIP/NSC.

Attending the conference as observers will be Dr. Chester Clark, special assistant to the American ambassador for science and technology, and Ambassador Edward Kwan of the Ministry of Foreign Affairs.

Fertility of Male Oyster Gametes After Freeze-Thawing

Shuh-wei Hwang and Huei-Pin Chen

Technical development in the application of ultra-low temperature, including success in preserving the entity of various types of organisms, has given man better insight into the concerns of life processes. This increased capability will enable man to till biological resurces for his needs. A good illustration of this point occurred in the cattle industry. A supply of selected bull semen *in vitro* has been made available to cattle breeders for over two decades. Many biologists are interested in the response to freezing of spermatozoa of domestic animals such as pigs, sheep or fowl. In 1971, a semen bank for man was established in New York (the Idaut Corp.). In the American Type Culture Collection (ATCC), liquid nitrogen (LN) preservation has been adopted as one of the methods for the long-term preservation of living cultures of seven kinds of microbes (ATCC Annual Report). The prevalent fact remains that unicellular organisms have a better chance of avoiding mortal injury inflicted by the freezing process.

After Blaxter reported 85% fertility for the frozen-thawed herring spermatozoa (1953), general interest in the preservation of fish sperm was aroused (1972). However, not until Lannan's study (1971) was the oyster, *Crassostrea gigas,* sperm exposed to -196°C (liquid nitrogen). Our present attempt was to test the response of oyster sperm to the freezing process in the presence of cryoprotectants. This will verify the probability of success in the long term preservation of oyster sperm for the convenience of fish culturists as well as geneticists. When a champion strain is developed, it will manifest a joint effect on many branches of science.

**This study was partly supported by the U.S. National Science Foundation, implemented by the Sino-American Science Cooperation project with assistance from the Joint Commission on Rural Reconstruction, the Tungkang Marine Laboratory of the Taiwan Fisheries Research Institute and the American Type Culture Collection. The article is reprinted from the Joint Commission on Rural Reconstruction Fisheries Series No. 15.*

Materials and Methods

The oysters, *Crassostrea gigas,* used were obtained directly from a local oyster farm and held in a concrete tank in the laboratory compound. The experiment began with the determination of sex when fresh oysters were taken into the laboratory from the stock tank. The individual was carefully detached from its shell and determination of sex was made by microscopic examination of a smear taken from the oyster. The females were temporarily stored in the refrigerator at 14°C temperature for the fertilization tests of the same series later on.

The males were placed on double layers of dry, clean cheese cloth. With the sharp edge of a micro-slide, the sperm sac (gonad) was readily split and the milt collected in a dry 100 ml beaker. Three to four ml of milt were collected from 40-50 fresh oysters.

Cryoprotectants:—Glycerin and dimethyl sulfoxide (DMSO) were the protectants used. The concentrations were 20, 15, 7.5, 6.6, 5 and 3.3% respectively. Marine saline was the diluent for the preparation of the various concentrations.

Marine saline formula:—

NaCl	1.35g
KCl	0.06g
$NaCHO_3$	0.02g
CaC_{12}	0.025g
MgC_{12}	0.035g
distilled H_2O	100.00ml

Freezing:—One half ml or more of milt from the collection was delivered into a freezing vila o.d.=20mm×48mm). An equal quantity of a double strength solution of the selected protectant was added. After gentle agitation, the final concentration was reached. With a graduated pipette, an equal amount of this mixture was distributed among a series of freezing vials. Thus, for each exprimental run, three to five ampules were prepared for each concentration at one time, each with 0.2 to 0.5 ml per ampule.

The freezing was uniformly done under the condition of extremely fast and uncontrolled cooling. The cryogen was liquid nitrogen (-196°). The ampule to be frozen was quickly plunged into the cryogen with about 2/3 of the vial below the liquid level. About a minute later, turbulent boiling subsided. This signified that the specimen temperature had attained that of the surrounding cryogen. Thus the sperm cells were frozen and might be kept at—196°C for some hours until needed for fertilization.

Thawing:—After being taken out from the LN bath, the lower part of the ampule was immediately immersed in a 20-24°C water bath and stirred gently. When the last trace of ice had disappeared, the vial was taken out from the water bath. Because these vials were not heat sealed, care had to be taken to avoid water influx.

Insemination:—The females were the oysters previously examined. The collection of eggs was no more different than the collection of sperms. A mass of about 300 or more eggs was transferred to a 1,000 ml beaker. The contents of a thawed ampule were emptied onto the egg mass. A small amount of sea water was first added and gentle agitation might also be applied. Thereafter, the beaker was filled with sea water. Two or three washings were performed at about 30-minute intervals. Finally, aeration was supplied to each of these beakers.

This experiment was conducted at room temperature (28-34°C). Exposure of sperm to liquid nitrogen varied from two to five hours. Slowly rolling fertilized eggs might be seen with unaided eye. The quantity of fertilized and unfertilized eggs was determined by counting the rolling and stationary eggs within the same view under a profile projector (Nikon, Model 6C) about 5-7 hours after insemination. Sometimes a second count was taken for further confirmation at longer interval.

Results and Discussion

The fertility of frozen-thawed sperm and other preparations after insemination with fresh eggs is shown in Table 1. Dimethyl sulfoxide (DMSO) gave much more effective protection to the subjected cells than did glycerin. Among the seven con-

centrations administered, fertility percentage was obviously highest in the DMSO samples. The best result of 78.98% was obtained from 7.5% concentration.

When the protectant was in contact with the milt, the liquid in the vial appeared somewhat dense. During the insemination operation, at the addition of sea water, some milky gelationous substance was found in every beaker. The amount appeared to be proportional to the concentration and/or the amount of the protectant. However, this phenomenon was more obvious with the glycerin samples. In these beakers, turbidity showed up more often and sooner.

Table 1. Effect of Cryoprotectant as Indicated by Fertility of Frozen-thawed Oyster Sperm

Cryoprotectants Concentration (v/v)	No. of Experiments	Glycerin		Zero Fertility	Dimethyl Sulfoxide (DMSO)		
		Samples Taken	Fertility* Average %		No. of Experiments	Samples Taken	Fertility* Average %
20%	—	—	—		1	4	28.34
15%	1	2	0.28	0(2)**	2	8	6.87
10%	1	7	0·0	0(7)	4	15	51.03
7.5%	4	6	1.03	0(9)	2	7	78.98
6.6%	1	3	0.49		1	3	31.27
5.0%	4	13	8.74	0(2)	4	15	41.12
3.3%	3	12	3.88		—	—	—
Others: Saline: Sperm 1 : 1	3	10	2.29				
Sperm, undiluted	4	14	39.48				
Control 1 (fresh sperm)	5	11	40.07				
Control 2 (egg only)	4	8	0.78	0(3)			

* Readings were taken 5-7 hours after insemination

** Number of samples taken

The four additional sets of experiments were aimed at validating the fertility percentage of the frozen-thawed sperm in the presence of protectants. As indicated, in the absence of these protectants, the frozen-thawed sperm exhibited 39.49% fertility. Apparently cryoprotectant was not an absolute necessity for the freezing of oyster sperm as required by other organisms.

However, when the sperm was suspended in marine saline and frozen, the thawed sperm had a low fertility (2.29%), less than the best result (8.74%) of glycerin samples at 5.0% concetration. A 0.78% fertility showed up in control 2 in which experiments no sperm was used at all. This fertility might be from contamination with sperm. The 40.07% fertility of control 1 (non-freezing sperm) was lower than some of the results of DMSO samples. One might speculate that DMSO could be acting as more than just a cryoprotectant. A third control, fertilization with non-frozen sperm suspended in DMSO, should be performed.

Cryopreserved sperm from our present study exhibited higher fertility than those from Lannan's (10.3% best). Could it be that ""sea water" was the causal element? In Lannan's freezing experiment, sea water was the diluent for the preparation of the DMSO solution. From our observations, sea water induced motility and activity of the sperm. Thus the vitality of the sperm might have been exhausted prior to the freezing process.

Summary

The male oyster gametes exhibited a high degree of resistance to injury inflicted by the uncontrolled fast freezing process. Between the two protectants, DMSO exerted a higher beneficial effect than glycerin upon the subjected cells. In 7.5% DMSO, the fertility of frozen-thawed sperm was 78.98% while the control (non-frozen) was 40.07%; the latter was comparable to the undiluted frozen-thawed sperm (39.48%).

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Anthropological Project Fruitiful

This last July saw the conclusion of the first phase of the interdisciplinary research project, entitled "Anthropological and Enviromental Investigations in the Choshui and Tatu River Valleys of Central Taiwan." Supported for two years (1972-74) by a grant of the National Science Council, the Choshui-Tatu Project has been conducted under the joint auspices of the Academia Sinica, National Taiwan University, and Yale University. Scientists from seven disciplines—archaelogy, cultural anthropolgy, geology, geomorphology, zoology, botany, and soil studies—participated in the research, which also provided data for the dissertation research of 6 Ph.D. and 5 M.A. candidates from various universities in the Republic of China and the U.S.

It is believed that man entered the Choshui-Tatu area several thousand year before our era. The earliest inhabitants were confined to the coastal and estuary regions, and their culture is characterized by red, cork-marked pottery. Beginning about 2,000 B.C., these early dwellers are seen to penetrate into the interior and the upland regions of the Choshui and the Tatu river systems, and their culture also underwent significant changes. The collaborative efforts of the scientists from the various disciplines have enabled them to make the initial reconstruction of the ancient microenvironments encountered by the early inhabitants, which may also provide some explanation for the cultural change. The history of this area is then carried down to the present time, stressing the ecological interaction among the various ethnic groups known in this area.

Of particular interest is the finding of extensive peat deposits at the bottoms of the P'u-li basins. Most of these are dated to late Pleistocene and early Holocene, and they contain enormously abundant data for the study of the ancient environment. The possibility of the discovery of Palaelithic Man in these deposits has been raised. The peats are, in addition, of significant economic value and are being studied for possible mining.

Sand-Wave Fields in Taiwan Strait

(*Continued from last issue*)

and Stevenson (1972) indicated that, in summer, the Kuroshio achieves speeds as great as 3 km per hr, and notations on Chinese Navy charts indicate that current speeds in some areas along the west side of Taiwan exceed 3 km.

During the winter, a southward-flowing countercurrent of cold low-salinity water along the coast of the China mainland reverses the summer flow in Taiwan Strait. These seasonal changes in flow patterns and the influence of submarine topogarphy and other topographic features, such as the Peng Hu Islands, probably produce large eddies in parts of the strait. Seasonal changes may thus alter the location, orientation, and size of sand waves in the strait, although these possibilities await investigation. In the coastal areas, the presence of tidal currents adds to the complexity of the current circulation patterns. Some workers have suggested that sand waves with symmeterical shapes occur in areas of zero net transport in a tidal cycle (McCave, 1971). The symmetrical sand waves in the coastal area near the northwest end of Taiwan (Fig. 1) may be an example of this type of devlopment.

SURVEYS

Echo sounding profiles were taken during the course of a survey conducted in Taiwan Strait during June 1973 to collect bottom sediment and to study the shallow, subsurface structure of sediment and rock. The surveyed tracks, shown in Figure 1, are oriented approximately normal to the west coast of Taiwan and extend seaward to about the midpoint of Taiwan Strait (political reasons prevent surveying beyond the midpoint). A Raytheon Precision Fathometer operating at 3.5 kHz and a recorder scale of 1 cm=20 m was used for profiling; navigation was done by means of a Magnavox Mx/702/Hp Satellite Navigation System, aided by radar and visual sightings. Because of frequent stops at sampling stations and some drifting of the ship, the track lines shown in the figure are smoothed approximations of the ship's actual track.

SUMMARY

The rather widespread development of large, asymmetrical sand waves in Taiwan Strait suggests active transport of bottom sediment. The pattern of sediment transport, although not yet accurately determined, appears to be complex; transport in a seaward direction, transport in a landward direction, and longshore transport are all indicated in various parts of the strait. The sand waves are developed in areas of sandy bottom sediment that Niino and Emery (1961) considered to be relict Pleistocene sediment; it appears quite likely, however, that the sediment has been extensively reworked since Pleistocene time by bottom currents that may have markedly altered original sedimentary structures and mineral concentraitons, as well as the local topography of the sea floor.

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Tsinghua Starts Plastics Project

The National Tsinghua University has started research on robber-modified plastics with a one-year grant from the National Since Council. Professor Hu Teh is in charge of the project.

This research project is intended to investigate and utilize the rubber modified plastics which include ABS (acrylonitrile-butadiene-styrene terpolymer), HIPS (high impact polystyrene), MBS (maleic amhydride-butadiene-styrene) and others. These materials share commonly an important physical property, impact resistance, for rough treatment on their molded products. This property makes these plastics indipensable for many engineering applications. Listed below are a few examples of their uses, TV cabinets, telephone sets, luggages, camping trailer covers, toys and many automotive parts.

The petrochemical industry in Taiwan is in a stage of rapid expansion. One of the industries planned is the production of ABS resin. However, the production of ABS resin involves sophisticated technologies which are protected by patents or by trade secrets, and the leading producers like Marbon or Dow, etc. are unwilling to license their first-rate know-how in order to safeguard their own competitive positions. Thus, for the sake of the future of a new indutry in the Republic of China, Tsinghua initiated this research project to study the rubber modified plastics. This project will be a continuous one and intends not only to improve product properties and the development of novel uses of the products, but also to serve an educational purpose—training graduate students at Tsinghua for national need.

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台北市廣州街二[illegible]
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