HYDRO-BIOLOGICAL SURVEY
OF THE
THONDAIMANNAR LAGOON

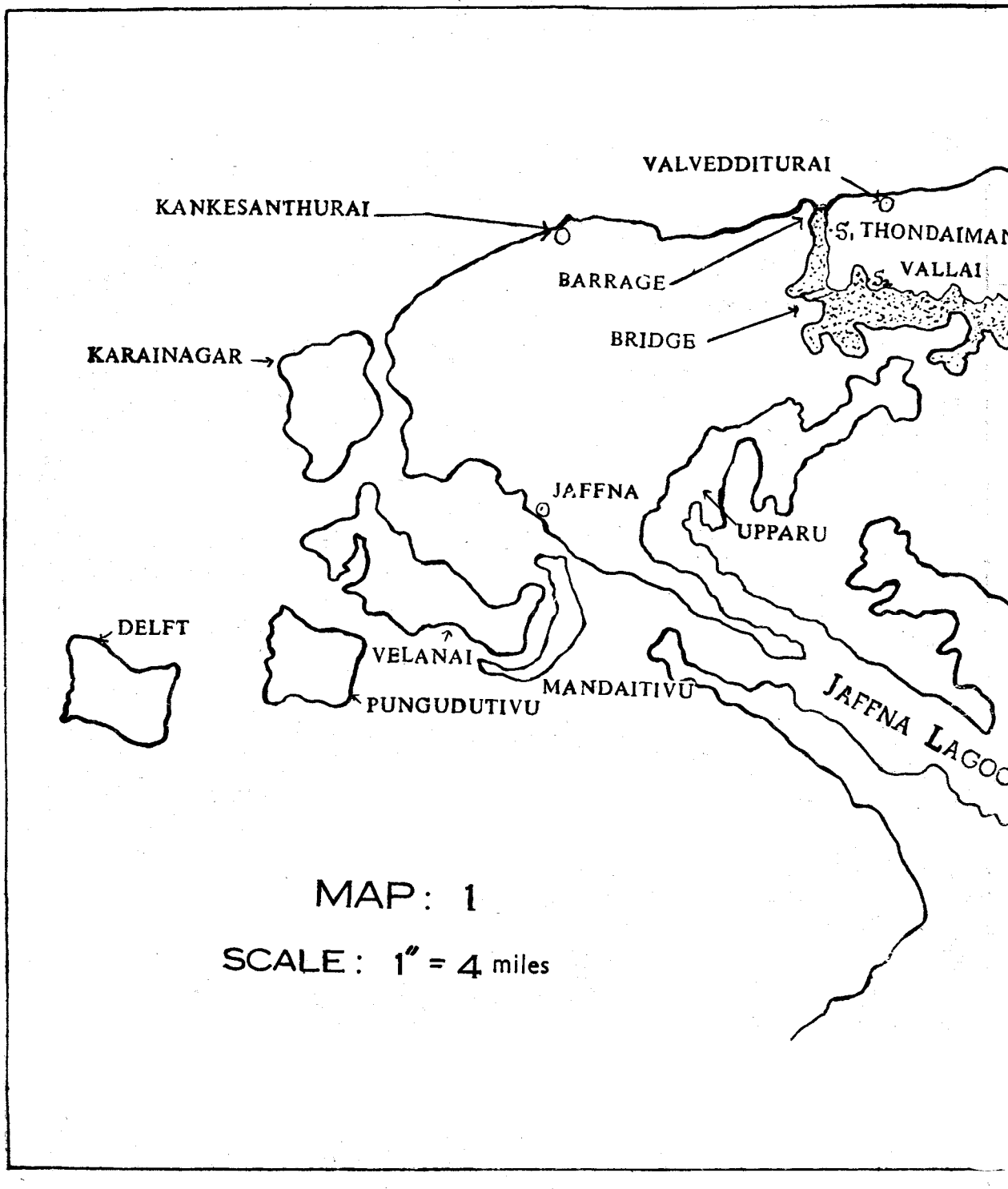
Bulletin No. 12

STUDENTS' PROJECTS

K. Sivapathasundaram
K. Ponnambalam
M. Atputhanathan

OCTOBER 1968

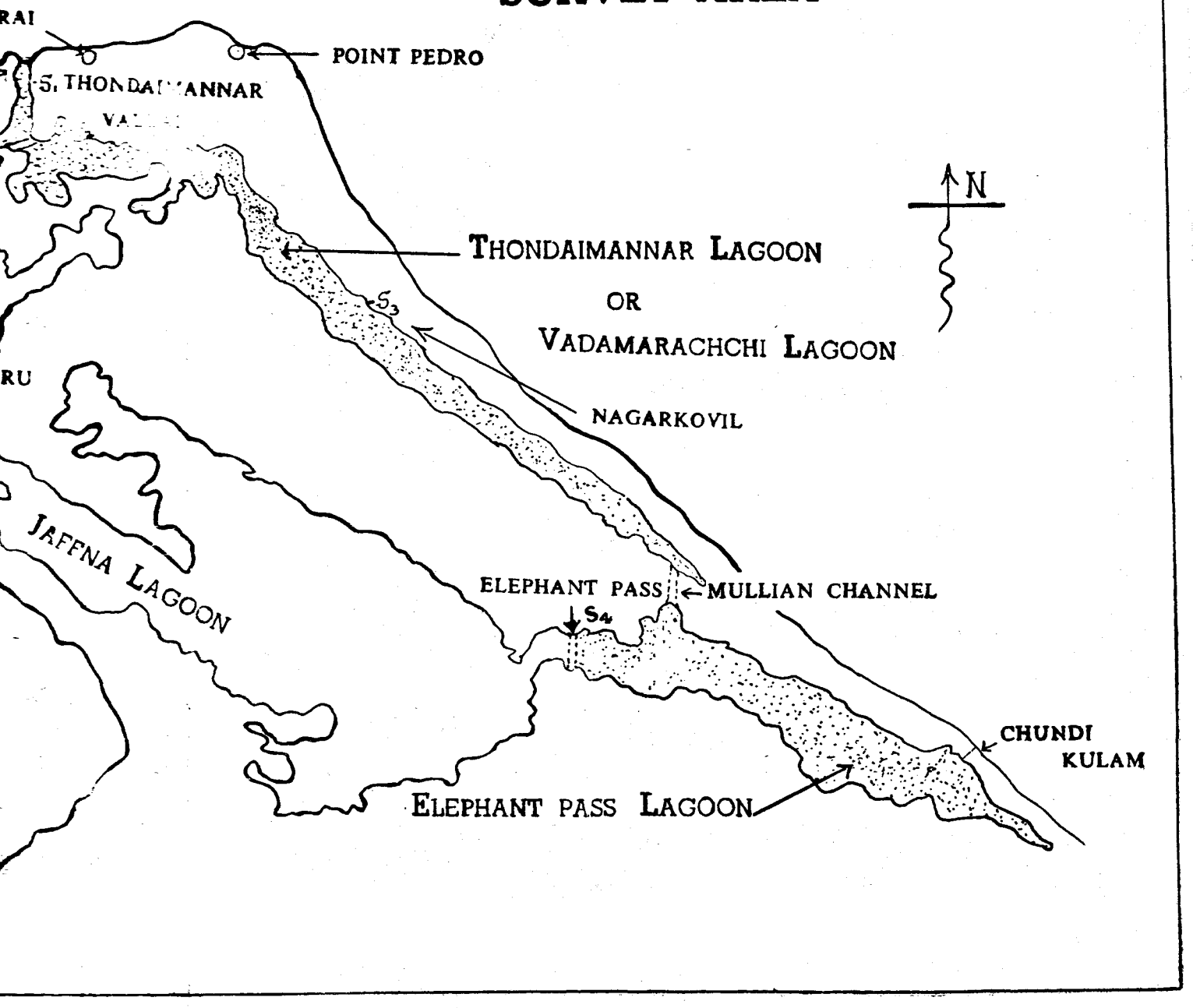
Published by the Hydrobiological Survey Research Council
of
The Northern Province Science Teachers' Association.



MAP: 1

SCALE: 1" = 4 miles

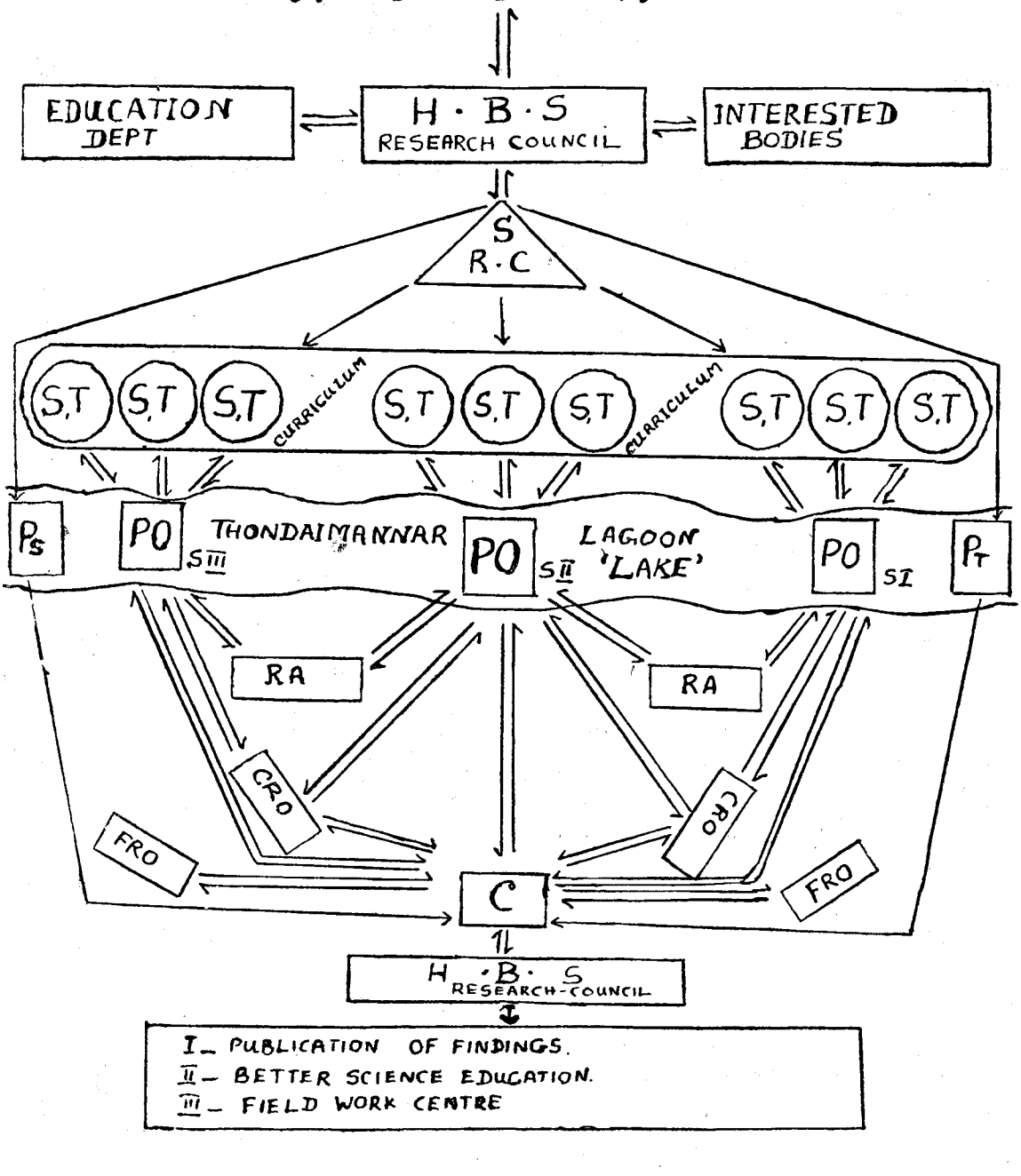
MAP OF THE HYDRO-BIOLOGICAL SURVEY AREA



DIAGRAMMATIC REPRESENTATION OF THE MANIFOLD IMPLICATIONS OF THE

HYDRO-BIOLOGICAL SURVEY PROGRAMME.

N · P · S · T · A



I – PUBLICATION OF FINDINGS.
II – BETTER SCIENCE EDUCATION.
III – FIELD WORK CENTRE

Guide to the understanding of Chart overleaf :

N. P. S. T. A—Northern Province Science Teachers' Association.

H. B. S. —Hydro-Biological Survey of Thondaimannar Lagoon.

S. R. C. —Secretary, Research Council.

S_3 T. —Schools; Students and Teachers.

PO. —Project Officers of Stations I, II, III, etc. (Members of Research Council.)

Ps. —Individual specific projects at student level.

Pt. — ,, ,, ,, at teacher level.

RA. —Research Assistants (Members of Research Council)

CRO. —Ceylonese Research Officers.

FRO. —Foreign ,, ,,

C. —Convener of this programme, (Chairman of the Research Council)

S_1, S_2, & S_3 —Working Stations.

Bulletin No. 12

Students' Projects

Compiled by

K. Sivapathasundaram
K. Ponnambalam
M. Atputhanathan

From the experiences derived by carrying out students' projects by various members of the Research Council at their respective schools.

OCTOBER 1968

Published by the Hydrobiological Survey Research Council of The Northern Province Science Teachers' Association.

CONTENTS

Errata

Preface	para	3	line	8	to read as	project studies
page 3	,,	2	line	3	to read as	field work appears to be
,, 3	,,	3	,,	1	,,	at Grades 9 & 10
,, 3	,,	4	,,	5	,,	year of study
,, 3	,,	4	,,	6	,,	last period
,, 4	,,	2	,,	3	,,	even allow projects
,, 4	,,	2	,,	7	,,	England Considers project
,, 4	,,	2	,,	12	,,	well equipped
,, 5	,,	2	in title and in (d)			'projet' to read as project
,, 5	,,	3	line	7	to read as	abundant
,, 6	,,	1	,,	3	,,	observations
,, 6	,,	3	,,	13	,,	procedures
,, 7	,,	1	,,	1	,,	relevant
,, 7	,,	3	,,	6	,,	peculiar
,, 7	,,	3	,,	8	,,	survey
,, 9	,,	3	,,	4	,,	For each aspect
,, 9	,,	5	,,	9	,,	for it is only
,, 12	,,	1	number 1 to read as			"the number of types of"
,, 12	,,	1	,,	5	,,	During dry season
,, 13	,,	2·1			,,	"planned for the first one

,, 15, Discussion No. 1. read as "of the 47 types of fishes 26 types of fishes had"

page 15 discussion No. 2 read as "These 26 types of fishes"

,, 15 ,, ,, 6 line 2 substitute "chart facing page 16" (for appendix 2)

,, 15 discussion No 6 line 7 after fishes substitute thus (ie those that come under 2·3 and 2·4 on page 14)

,, 16 para 1 line 4 read as "but experience gained over"

,, 16 ,, 2 ,, 1 ,, "as shown in para 6,"

,, 16 ,, 4 number 1 delete after market "and the other"

,, 16 ,, 5 line 3 read as "also made the relative abundance"

,, 16 ,, 5 ,, 7 ,, "lagoon do not form"

,, 16 ,, 6 ,, 5 substitute (chart facing page 16) for (see table 2)

page 17 para 1 line 1 read as popular varieties

„ 17 under comments No. 3 line 1 read as "the final write up"

„ 20 para 1 line 1 read as "Any interesting point arising"

„ 20 section 2·4 line 3 read as "project are to be given"

„ 25 last para line 2 read as "chart read at"

„ 29 praa 1 last line read as "46 watt bulb"

„ 29 „ 3 line 3 read as "devise such as blower'... .. "minimise heat dissipation."

„ 30 para 2 No. 3 line 1 read as matt screens

„ 32 „ 2 line 8 read as "heterophylla"

„ 33 „ 4 last line read as step short of

„ 34 Section 4·2, line 3 read as "weeds wilt under."

„ 37 para 1 line 1 read as "Seen a bird's nest"

„ 39 „ 1 „ 10 „ "Seen to live with them"

„ 43 No. 1 read as "Rhizophora mucronata

„ 43 No. 15 read as "Ostrea sp."

„ 44 No. 35 read as "Tilapia"

PREFACE

In section IV of Bulletin I, we have stated that we would briefly list some of the other outcomes congenial to learning science in the context of modern concept of Education. We indicated briefly some of the projects that had been successfully carried out, and those that await application. A detailed statement, of the projects carried out, the impetus that initiated those, the methods and procedures followed, the immediate and ultimate outcome, appear very significant, and hence this additional number.

One of the aims of the Hydrobiological survey of the Thondaimannar Lagoon, is the development of initiative and eagerness among students and teachers, and induce them to select, systematically analyse, and find solutions to problems through projects that suit or interest them. To those who had been lagging in intitiative, to those who grudge the want of precedents, or to those who find it difficult to select a problem and analyse it systematically in the absence of a some sort of ready-made procedure, we hope this number, prepared through experience gained by guiding and carrying out projects in schools will be a very much awaited guide. We hope that this number will contribute to the needs of the present approach to science education.

Through this number, we present the role of the students and teachers, in the selection and systematic analysis of projects, the methods that could possibly be adopted in the successful completion of those pursued, the assistance rendered by the hydrobiological research council and finally the gains and losses incurred by such minature research programme. The contents in this issue are so drawn up that the readers could, on reading to completion, become familiar in the necessary technique, and could take up project studies of his own and carry out to a fair degree of success. We fervently hope that an appreciable number from each school, indulge in project studies, and render a significant or appreciable contribution towards the betterment of science education and production of budding scientists.

That anything which is learnt as a result of personal experience is almost always better than that what is told is an accepted axiom in Education. When viewed in this perspective the importance of learning through projects becomes crystal clear. Projects go a long way in developing a healthy scientific attitude. It not only gives an added zest to the work of the science teacher who directs the pupils to solve new problems requiring the application of various

types of skills, but also taps at the latent talents and resourcefulness of the teachers and students. This type of fascinating work leads to inventiveness, which is the king pin of research.

Today project studies are being initiated, and pursued through the untiring efforts of the Hydrobiological survey research council. But unfortunately the council's tentacles have embraced only a few schools while in a very great number of schools project studies are never thought of. In the interest of modern approach to science, and in the interest of the nation, we wish that project studies occupy pride of place in the school science curriculum, and that the Deparment of Education would effect the necessary changes in the curricula and syllabuses.

THANKS

The research council is specially indebted to Asia foundation of the U. S. A. for their magnanimous gesture in seeing the results of our investigations go into print. On behalf of the Research council, we take this opportunity to thank the principals of J/Chithampara College, J/Hartley College, J/Nelliady M. M. V., J/Puloly Boys English School and J/Uduppiddy American Mission College, for providing necessary facilities to the students of the respctive colleges, in working out the projects, and contributing directly and indirectly in several ways to make this venture a success.

The authors are grateful to the other members of the Research council for thc very valuable criticism made towards this publication.

'Authors'

SECTION : I

The Project

1·1 What is a project?

A project is a specific study carried out by an individual (or a small group) largely on his initiative, involving experimental inquiry into some specific problem that has interested him.

The nature of projects differ, depending upon the experimenter's academic and Technical endowments, financial and physical facilities, mental and physical alertness, guiding and assisting personnel and the like factors. The student projects are mostly miniature in form, that involve little or no finance, and lesser use of laboratories, and equipments. The projects should be so chosen that they could be pursued with no interference with the examinations or the school curriculum specially when project studies have not found a place among the activities of the institution. The student projects should be aimed particularly at the development of research attitude-awareness of a problem and the designing and improvising of apparatus for the investigation. It is the means and not the end that carries weightage in student projects.

An individual acquires an eagerness, and becomes a participant when and if he associates himself with those engaged in project studies and surveys. The Hydrobiological survey research council, has induced many students to take on the project studies through its biannual surveys of the Thondaimannar Lagoon, and through the whole hearted co-operation and guidance of its members. By participating in regular surveys, and observing scientists at work, students come by, and become aware of the existence of problems, develop research attitude, and finally interest themselves with suitable projects.

Some of the student projects may be aimed at a verification of hypotheses, others may be aimed at studying particular physical conditions and or life prevailing in selected niches, and still others may be aimed at learning and correlating features common among individuals of any one community or race. It must be the student who selects his project or area of study. (Refer Section V)

1·2 Aims of a Project

Having briefly stated what a project is, we now proceed to enumerate reasons why student projects should be undertaken, and encouraged. Project studies provide.

1·2 1. Practice in recognising the existence of problems.

1·2 2. Practice in analysing a situation, and formulating possible means of approach.

1·2 3. Practice in forwarding hypotheses regarding the problem, by the application of what had been learnt or read in class-room, or through the contents of the syllabus.

1·2 4. Practice in designing experiments for the analysis.

1·2 5. Practice in the improvisation of apparatus. and use of materials in his environments.

1 2 6. Practice in the collection of data and recording preciously to the best advantage.

1·2 7. Projects help in the development of fundamental skills like (a) Measurement (b) Observation through the use of all the senses (c) Classifying data with regard to its importance and logical sequence. (d) Patience for research work.

1·2 8. Willingness to consider new evidence and to change an opinion or conclusion because of later evidence.

1·2 9. The projects help students to develop an appreciation of the contributions of some eminent scientists and their discoveries and methods.

1·2 10. The projects help in the realisation of the importance of books, journals, records etc.

1·2 11 The ability to evaluate the evidence, correlate the data and to draw conclusions on the basis of evidence at hand and from the data collected from associated projects.

1·2 12. Through projects one gains the ability to compile an account coherently, concisely and lucidly.

In general it can be said that projects help one to develop scientific methods as a way of thinking and solving problems, to develop the creative powers and skills, to develop an appreciation of the contributions of the scientists, and to develop interests for leisure time activities. A successful project carried to completion can provide a student not only opportunities for ingenuity, initiative and independance, but also a deeper understanding of particular problems of his environment, and thc willingness to work.

SECTION II

Organisation

2 · 1 Project and curriculum

In many countries the "subject" mode of organising the curriculum is being replaced, It is said that "subjects" are no more than museum pieces. The curriculum should be thought of in terms of activities to be encouraged rather than of things to be learnt by memory. Hence the importance of learning through projects. Curriculum content should be organised so as to make this new approach possible, and to stimulate real and deep interest in the learners.

Today the prescribed syllabus and the curriculum do not demand or require project studies. They are archaic and didactic in outlook. In some schools even the field-work appear to be barred for the simple reason that it has to be done outside the four walls of the class-room. The content material only is stressed, and the mere outcomes of the syllabuses are interpreted as the mark scorers. Though in the greater interest small projects could be worked out during the spare time with little or no interference with the school curriculum, teachers and students do not indulge in it, being "materialistic" in outlook and examination centred in aim. As stated earlier it is our fervent hope that the Department of Education will at the earliest, include project studies in their syllabuses and pave the way for the students to apply their knowledge, scientific method and skills.

Project studies could preferably be taken up at Grodes 9 & 10 and 11&12 stages in our schools. At the present context students should pursue such studies, during their spare time and outside class-room hours. The authorities may exempt, those students braving with project studies, from some of the co-curricular activities thereby giving them additional time, initiative and encouragement.

When and if the Department introduces project studies through the curriculum, we would advocate (with the experience gained in guiding and supervising some student projects worked to completion) an allotment of one period of forty minutes per week during the second year of study. It would be advisable if the period allotted is the ast period of the afternoon session. Provision in the timetable is not the only criterion. For the successful completion of projects,

there must be at least the bare minimum requisites like laboratories, libraries and equipments. A laboratory for this purpose need not be one that is spacious and equipped, but even a small protected area available to students during their free periods and spare time, and where interference by other students would not occur is quite sufficient. The school authorities must try to procure recent journals, and magazines relevent to project studies and help the students in their endeavours. Some of the science teachers of Vadamaradchy, having felt the importance of project studies, and the importance of laboratory and library facilities for such studies, have associated themselves into a 'society for the establishment of a school science field work centre" and are making efforts to set up a laboratory cum library on the banks of Thondaimannar Lagoon, to facilitate students and teachers pursuing project studies. The Hydrobiological research council extends its kind co-operation to that well meaning, far thinking society. This laboratory cum library will, we are sure make amends for the deficiencies, prevalent in our schools.

Since project study occupies a very significant position in the modern approach to science learning, it will not be illadvisable for the school authorities to even allowing projects to be substituted for a subject taught abstractly. At this context it may be said that some universities in North India exempt students taking on to Cadetship from one subject, as an incentive to fulfil nation's requirements. One of the Examination boards in England consider project study in awarding certificates. If cadetship can be encouraged why not project studies which lead to the building up of individuality, confidence and scientific attitude. The Research council's considered opinion is that, even at the denial of some of the above stated facilities, like provision in the timetable, a well equiped laboratory and sufficient reading materials and encourgement, projects could be pursued at the Students' and Teachers' levels, if the willingness and frame of mind are there.

2·2 Teachers Role in Student Projects.

The role of the teacher in student projects is one of a guide and not a director. He should not actively participate, but must passively interest himself. He has to appear at the stage, at differernt places of the project, and at intervals when his presence is solicited.

2·21 Teacher in the Selection of a Projet.

The teacher must take upon himself the onus of guiding the students in the selection of suitable projects, for a teacher is the best judge of a student's abilities. In advising a student in the selection of a project, the teacher should in the interest of the project, and the student's prospects, take into consideration,

(a) The capabilities of the student
(b) The nature of work involved
(c) The approximate time required for the successful completion
(d) The availability of the source of projct.
(e) The availability of laboratory facilities if and when required
(f) The availability of reading material suitable for the project.
(g) The availability of finance and
(h) Previous experience of the student in project study.

A stereo type method of selection cannot be suggested for it varies with the innate capabilities and aptitudes of the students and the subject area suitable for a zone. The project should however be selected from a limited area of study, and at the student level be specific or particular. It could be from chemistry, physics, biology mathematics or grography, but preferably from subject in which abunndant literature is available to the student. If different areas of science and greater number of problems within an area, could be investigated by the students of a school, the enthusiasm and benefits will be wider and greater.

2·22 Teacher's part in guiding the students through their projects.

The teacher should instil in the minds of the students the prospects of project studies. Some of the results might go against accepted principles, or some of the projects fail to produce desirable ends, or even come to a deadlock, but at every instance the teacher

should observe and make the students to comprehend that 'it is the means and not the end that is significant, and that contradictory results or obesrvations are equally important as those that fall in line with the accepted principles.

The teacher could help the students in the collection and use of reading materials. Students left to themselves alone might lose much of their available time, and some might be left in the lurch. The language difficulties of the present day student population is varied and a helpful guide may also be called upon to explain or even to give translations, comprehensible to the students. For appreciable results to be produced, the teacher could assist the authorities in the purchase of books, journals, magazines and the like, helpful in project studies.

As the student engages in his project, the teacher could advise against concepts or techniques that are difficult, undesirable, and that consume more time and effort. The teacher could arrange for periodical discussions with the students, to estimate the difficulties and progress of the student and offer suggestions to the needy. It may become necessary to change the sequence of enquiry, or the method of approach or to discard the apparatus designed, or even to select a new project. It would be best if the teacher could make the students realise for themselves (a) the difficulties encountered (b) the reasons for the occurrence of those difficulties (c) the possible modus operandi that could be adopted — project method of approach. As hinted earlier, the teacher should restrain himself from enunciating methods and proceedures.

In addition students can make the best use of the available laboratory facilities only with the good will of the teacher. Although a laboratory cannot be left at the disposal of the students carrying on project studies, the teacher could arrange for a protected area, where those not engaged cannot find admission, and where experiment and apparatus set up will remain unhampered.

Microscopic observation, and true and accurate recording are the prime factors that help in drawing up deductions and conclusions. During preliminary discussions, the teacher should indicate the

necessity for the recording of all the observed information relevent or otherwise, any improvements on the methods earlier laid down. along with the reasons for the changes. The value of repetitions should be stressed, and the students must be made to realise that in science if 20% of the trials produce the same result, the result is appreciated, a 30-40% is considered of some value, and only 50-60% is approved as significant.

Students on the successful completion of their projects would proceed to arrange the data, correlate them and possibly draw hypotheses or conclusion. Even at this final phase, the teacher plays an important role. It is only the teacher who impresses upon the student the importance of the use of data collected from studies pursued earlier or at contemporary periods. In composing, and presenting, the students must be made to understand the necessity for coherence, lucidity and brevity.

2·23 The teacher as a Liasion Officer.

The teacher can help in the sharing of experiences among the students. Through special classes or discussions, experiences could be shared, and this would enable training students to become equipped to surmount their difficulties and hurdles. The teacher could consult and receive guidance and direction from those qualified in the special fields when pecuilar or difficult or unaccountable steps fall on the way during the investigation. It may be mentioned that Hydrobiological survery research council provides a forum to perform this function.

Futher it is left to the teacher to appreciate, commend and even to take steps for publishing worthy results, but it must be borne in mind that those projects which are not completed due to circumstances beyond the control and reach of the participants do not get disapproval or condemnation. The teacher could also arrange for seminars under the auspices of recognised local science bodies, where the students could participate and share the experience with those of other schools. If any project study has resulted in finding of appreciable, recognisable, or significant nature, it could be presented to research bodies for perusal and acceptance. The hydrobiological

survey research council always interests itself in the promotion of research, and shall if demanded would recomend to the C. A. A. S., through which national appreciation could be achieved. In addition the school authorities could be influenced to publish a selection of the successfully completed projects and make those available to posterity. These would serve as the best guides to those who are to take on project studies.

2·24 Teacher as an evaluator.

Evaluation of a piece of work done forms a significant aspect in assessing the progress made, the needed assistance, and originality of the participant. The evaluator must maintain progress cards, for each student or project, wherein he could record all his observations from the time a project study is launched, till it finds completion. Evaluation calls for sincerity, as it helps to study the progress made by the student, and the student himself. The reports may also be useful when such assesssments are called for, by the examining body if and when project studies are incorporated in the curriculum. The assessments should be based on

1. Record of work-which involves
   (a) Neatness
   (b) Systematic recording
   (c) Truthful recording
   (d) Compiling and preserving data collected.
2. Originality in approach, which may be gauged by
   (a) Recording
   (b) Finding solutions to problems as they crop up
   (c) Improvisation of apparatus
   (d) Presentation in the write up
3. Impressions formed during progress-which may be based on
   (a) Accuracy
   (b) The steps taken and the quickness in deciding
   (c) Perseverance and devotion
   (d) Help or guidance sought

4. Interview when the following could be assessed
   (a) Background knowledge
   (b) Reference made
   (c) Difficulties encountered and how they are overcome
   (d) Applicability of the results to social problems
5. The final write up, where the evaluator has to look for
   (a) Analysis of data
   (b) Synthesis of data
   (c) Logical presentation
   (d) Illustrations

We would recomend that each of the above aspect to be evaluated on a five point scale and from the raw marks scored, the grades can be assigned.

Scheme		For the Project	For each aspest
Distinction	A	22—25	5
Good Credit	B	17—21	4
Credit	C	12—16	3
Pass	D	7—11	2
Weak pass	E	1— 6	1

Its only the true evaluation that would initiate and accelerate project studies. Of all the duties of the teacher, that of Evaluation, though difficult is the most important.

External Moderation

In addition to the teachers continuous and thorough evaluation, the research council advocates for an external moderation of the assessments, to establish a uniformity and standard. Further it is natural for a teacher to be biased in evaluating projects that are either too familiar or too alien to him. If and when as we hope, project studies are incorporated in the curriculum, moderation by an outside agency becomes a necessity-but then in any case, moderation must be based only on the teachers evaluation and in consultation with him, for its only the teacher who had observed the student round the year.

The moderation board at present consists of experienced members of the Hydro-biological survey Research council—in future it may be a body appointed by Examination bodies. The members of the board have to visit the schools on invitation, and moderate the assessments in the light of

1. The Final write up
2. The Progress card maintained by the teacher
3. A discussion with the teacher
4. An interview with the student if necessary.

SECTION : III

Trials

In this section we present two trials on project studies attempted to satisfaction by the students, revealing how project studies could be initiated and pursued. They were worked out by students during their spare time, and with no interference with their co-curricular activities. In fact some of the students involved interested themselves also in activities like sports and games, oration and dramatics, taxidermy and photography.

TRIAL I

Investigating the economic potential of the fishes found in the Thondaimannar Lagoon - 'Lake.'

Students participated

S- Santhirasegaram
G. Puviranjan
R. Siritharan
A. V. Radhakrishnan

College : J / Chithampara College; Valvettithurai
Teacher / Guide : M. Atputhanathan Esqr.
K. Chithravadivelu Esqr.

Investigating the economic potential of the fishes found in the Thondaimannar Lagoon – 'Lake'

This problem was given to a group of students (four). The background of the problem was explained to the whole class of seven students of the G. C. E. A. L. Second Year. The following points relevant to this problem were explained to them.

I. On a survey made during the last five years the number of fishes collected from the Thondaimannar Lagoon is 47.

2. This is made up of fishes belonging to eleven orders comprising 32 families. (A complete list of fishes with their vernacular names was given to each student and thorough acquaintance was made of each one them. (see appendix i)

3. Some of these fishes are confined to different parts of the lagoon while others are found over a larger area of the lagoon and still few others prevalant all over the lagoon.

4. This lagoon stretches over a distance of nearly 21 miles and holds water during rainy season in an area of 30 sq. miles.

5. During rainy season the water recedes to about five sq. miles.

6. This lagoon could form a potential source of fish.

7. These fishes could be either from the endemic species present in the lagoon or we could introduce suitable fishes and convert it into a fish farm.

8. As a first step to this problem of making use of the fish from the lagoon one must study to what extent the present population of fishes are of economic importance.

Method: –

As to how one can set about collecting facts for this problem was discussed with the whole class and the methods evolved are given below.

1. It is imperative that the visit to the fish market should form one of the important methods of collecting information.

1.1. It was decided that the biggest market namely Pt. Pedro

market where fishes from all over come, should form the centre of investigation.

1.2. Thondaimannar market though small, being close to the lagoon was also selected. A third market namely Atchuvely was also selected but later dropped off.

1.3 It was decided to make a preliminary visit to the market and find out the time when the market is at its peak of activity.

1.4. Since in the collection of data a rough count was the only possibility in the case of fishes coming in large numbers. it was agreed that two students should collect data from each market to minimise personal error.

1.5 The data was collected every other day for a period of two weeks. On each data sheet two days data to be entered, signed, and posted immediately on the second day itself.

2. Collection of opinion from various consumers in the area, the fish salesmen and observation and discussion with the fishermen in their areas, were to form another aspect of the data.

2.1 This is also done on the same form planned for first one.

3. It was also agreed that the teacher wiil also make his independent observation in both these markets and collect the data regarding 1 & 2 (This was meant to make the students to be on their alert and at the same time to cross check the data. It also will make the students feel that the teacher is one with them.)

Execution:—

After the general discussion about the problem and the planning of the methods of collecting data about the problem, volunteers were called and four of them were selected. In selecting, consideration was given to the proximity of the market and a thorough grasp of the variety of fishes. The work was spaced during a school vacation. This was also the time when the lagoon was fairly full and the catch was at its highest. This fact was explained to the students; but they were told that in the collection of data they need not worry as to from where the fishes came for we are only interested in finding out whether the

particular variety is in demand. It is immaterial from where it comes.

Assembling the data

This aspect of the work was done by the four students with the guidance of the teacher.

1. They produced first the histogram of the frequency of the counts that they have taken in the two markets. They had to discard certain data for they were found to be incomplete. This gave them an idea of the frequency of appearance of these fishes in the common markets.

2. The opinions from consumers salesmen and fishermen were translated into a five point scale of impression. The following points were given to each fish after going through the remarks written by their colleagues and the teachers.

2. 1. The fish that is highly valued was given *five* points.

2. 2. The fish that was generally in demand but not so highly valued as a delicacy was given 4 points.

2. 3. The fish that was generally valued but bought because it was comparatively cheap was given 3 points.

2. 4. Fish normally not bought, but bought as a last resort when there are no other fishes in the market and the one that is normally thrown out by the fishermen when he has variety in his catch was given 2 points.

2. 5. Fishes always thrown by fishermen and not recorded as eaten by the population surveyed was given 1 point. Some of those variety of fishes may be of importance in some other section of population and hence 0 was avoided.

2. 6. This was drawn in the form of a polygon across the Histogram to give better picture of the valve of fishes.

3, Question was raised whether the absence of some of the fishes in the market was due to non availability in the fishing centres or the poor value they fetch in the market. In the form of a partial answer to this question the data of the catch of each of the fishes collected during 24 hrs., during the survey

carried in the last five years was made available (8 such data was provided for each fish) this was also plotted in the form of a polygon acros the histogram.

Discussion:—

1. Of the 47 fishes 25 fishes had appeared in the market. The rest did not appear at all.

2. These 26 fishes may have been the most popular fishes provid ed all the other fishes were also caught.

3. That is, the other possibility is that the fishes that were not represented in the market may have been not caught during the period of investigation.

4. Another possibility was that the fishes were less popular and were discarded by fishermen.

5. Or not brought to the market in the presence of more popular variety like the 26 fishes.

6. The second line of investigation involving opinions were plotted in the form of graph. (See appendix 2 in dotted lines). This showed that of the 21 fishes that had never been reported in the market, only 7 come under fishes which are categorised as those that are bought because they are cheap and found in abundance and normally not bought in the absence of the other fishes. Further 14 of the 21 fishes are normally not bought even by the second method of investigation the difference between these two numbers is not significant and hence it fairly safe to rely on the information collected by these two methods. Therefore the line of argument postulated in five is is not valued. The fourth may be true because these fishes are being caught at least in the lagoon.

In the second method of investigation 14 fishes were economically unimportant. Therefore the mean value $\frac{(21+14)}{2} = 18.$ $\frac{18}{47} = 0{\cdot}4$

7. If we take the second possibility given in para 2, we will find that possibility came because we were counting the number of fishes in the market and making that as the indication of the

popularity. In the second line of investigation numbers were not taken into account and the opinion of various people were based not on the availability of those fishes in the market during the period of investigation but experience over many years.

As shown in para 4, there was no significant difference in the result of these two investigations; further, data on the relative abundance of these fishes in the lagoon (continuous line polygon) showed that they were being caught in the lagoon over a period of five years, at various times, including this period of investigation,

Thus it is highly improbable that the fishes that had not appeared in the market were due to the fact that they were not caught.

Conclusion: –

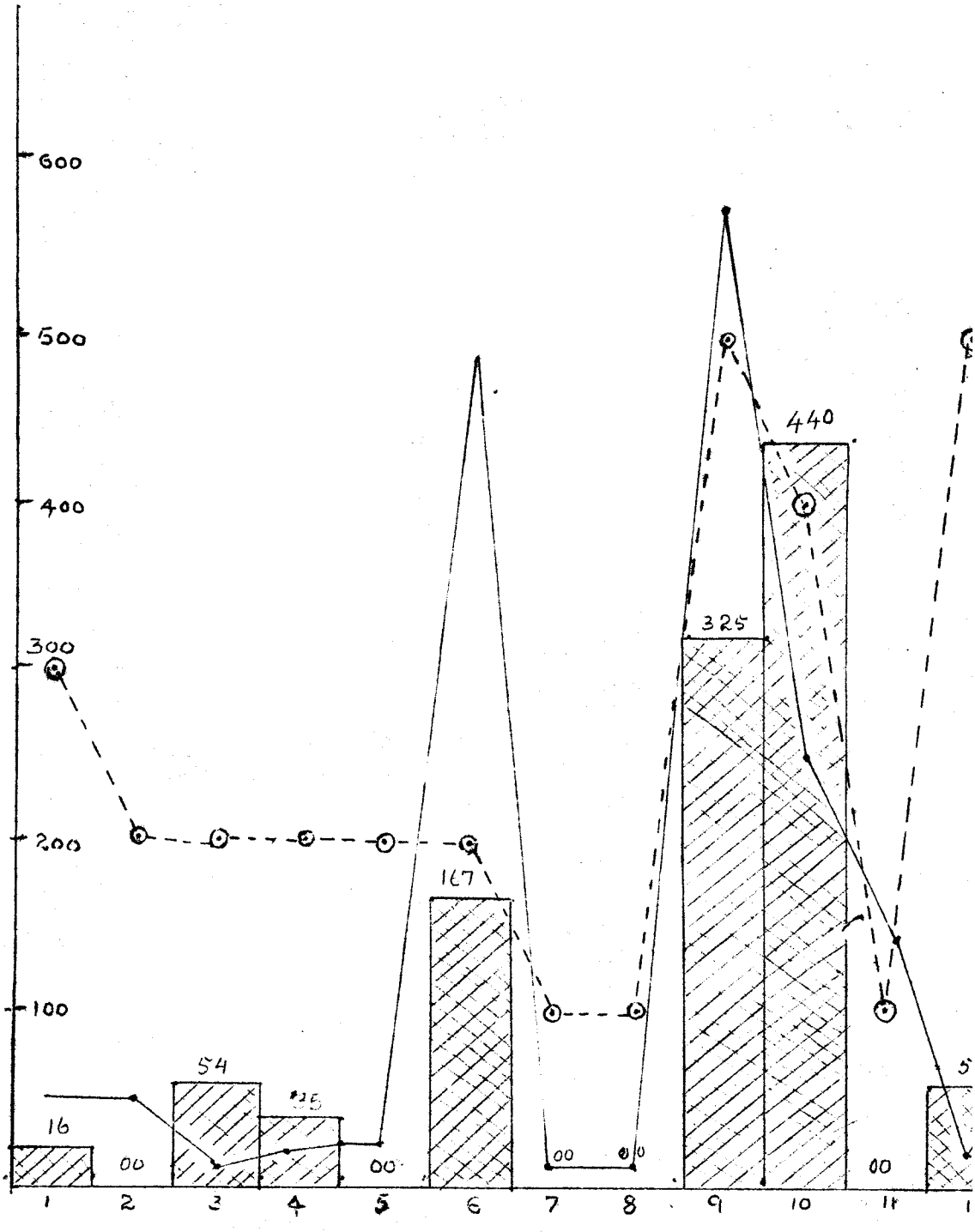
In our investigations of the economic potential of the fishes of the lagoon, we definitely followed two lines of investigations. (1) Basing on the frequency of the appearance in the common market and the other.

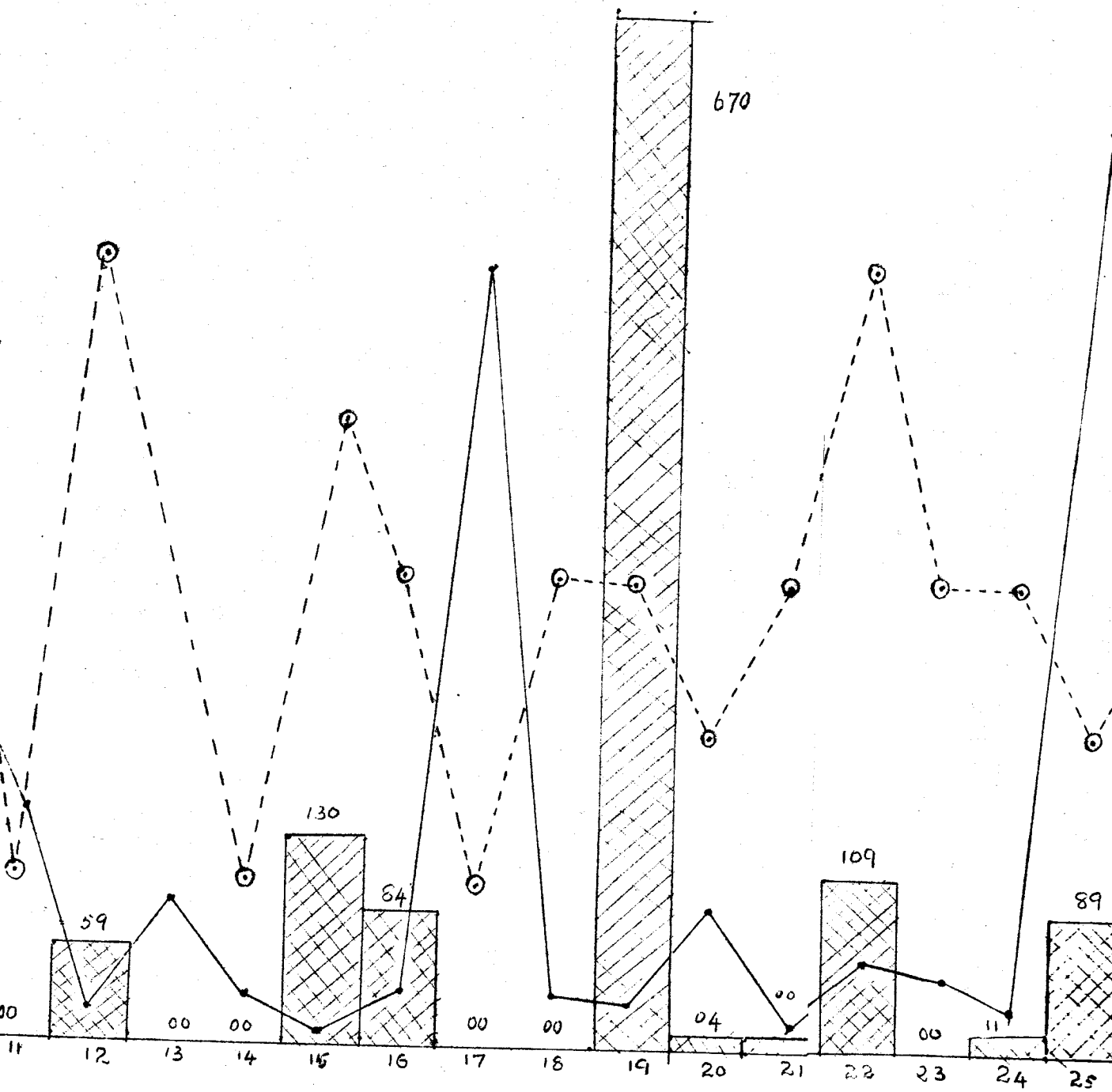
(2) On the opinions collected from their consumers, sellers and producers.

We have seen that one substantiates the other within the degree of freedom statistically allowed in such type of data. We have also made one of the relative abundance of the fishes of the lagoon taken from a stratified random sample to support the assumptions, that emerged from our earlier investigations. This has a limited value because, the fishes from the lagoon does not form the major supply to the market.

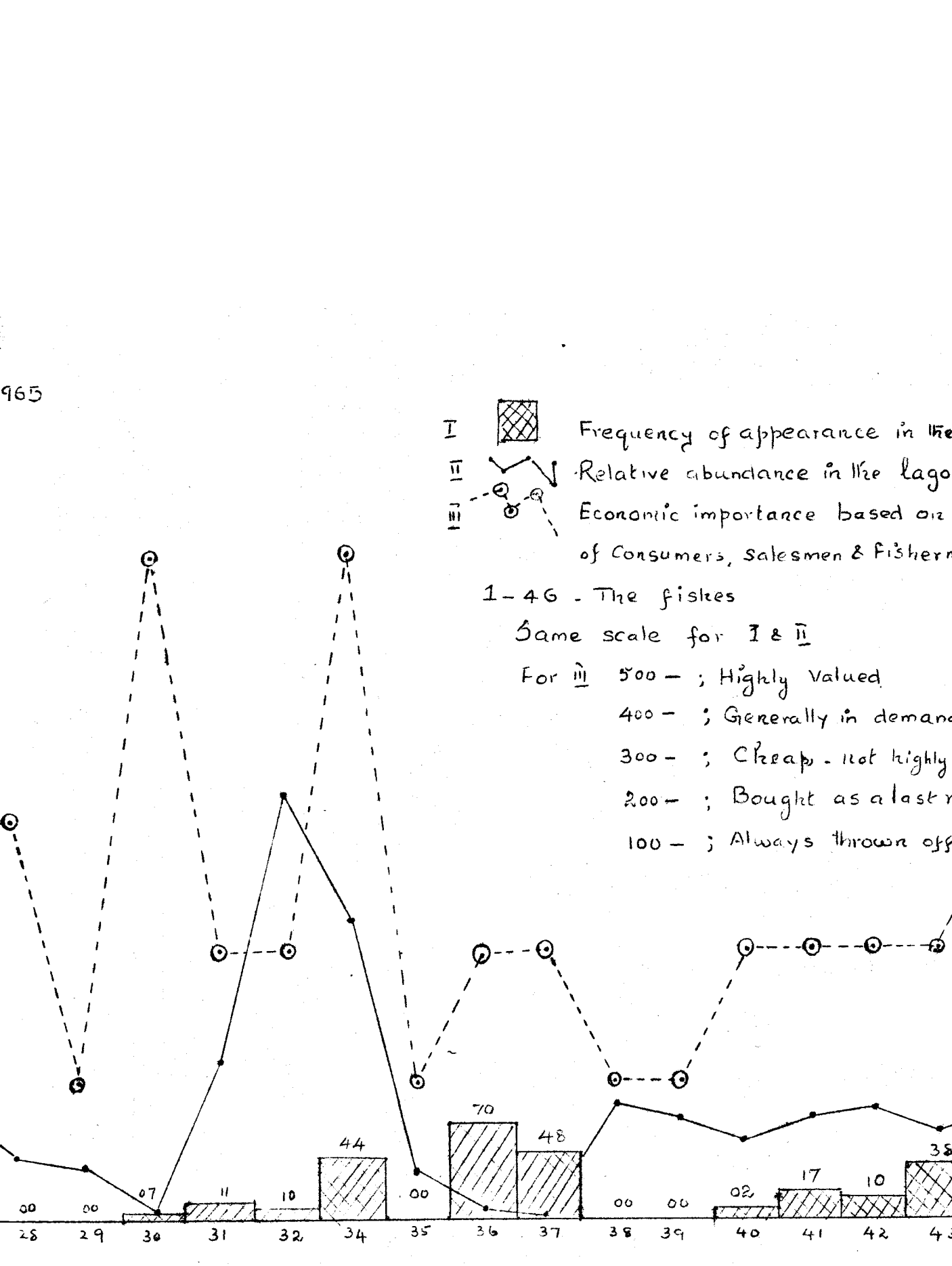
The facts thus reveal that we can to a greater extent postulate that fishes coming to the market have a relevance to their economic potential and hence we may be on safer grounds to put forward the fact that about 40% of the fishes of the lagoon are not of economic importance (see table 2.). This does not mean that some of these fishes may not be popular in the interior parts of the Island where fresh marine fishes are rare.

This takes us to the problem of the possibility of exploitation of the fishes of the lagoon as a source of fishes for the popu-


600
500
400
300
200
100
16
00
54
25
00
167
00
00
325
440
00
5
1
2
3
4
5
6
7
8
9
10
11


670
130
84
59
109
89
00
00
00
00
00
00
04
00
00
11
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

965


I
II
III
Frequency of appearance in the
Relative abundance in the lago
Economic importance based on
of Consumers, salesmen & Fisherm
1-46 . The fishes
Same scale for I & II
For III 500 – ; Highly valued
400 – ; Generally in demand
300 – ; Cheap . not highly
200 – ; Bought as a last r
100 – ; Always thrown off
00
00
07
11
10
44
00
70
48
00
00
02
17
10
28
29
30
31
32
34
35
36
37
38
39
40
41
42

lation. Only two of the popular variety (that is those that are above the average in their frequency of appearance) of fishes are found among the nine varieties that are abundant in the lagoon. (These are the forms above the average in our frequency counts).

In thinking of introducing fishes one may have to look into problems among others.

(1) The elimination of undesirable varieties.
(2) The cause of the increase in population of such varieties.
(3) The food habits of the introduced varieties.
(4) The type of habitats available in the lagoon.

Assessment of the Participants is as follows.

	Raw Marks	*Grade*
S. Santhirasegaram	25	A
G. Puviranjan	18	C
R. Sritharan	16	C
A. V. Radhakrishnan	21	B

Comments on the project

1. Evaluation of the project was very useful and this gave us high correlation with the general performance of these students and this indicated with all its limitation that our method of continuous evaluation was more practicable than the few hours of testing.

2. One Project should not be given to more than 2 students. There was a tendency of lack of co-ordination and even one relying on other for the completion of the work. Even when selecting two it was found that they should be living close together.

3. Considerable help had to be given to put the final right up (done in Tamil). This may be because our students do not have any previously written up material to be guided by.

4. The use of laboratory at their free periods was found to serve very useful purpose.

5. This project was a guided one. The reaction of two students tended to be not very much encouraging. This may be because that they have not selected it or may be that the other

two had been taking lot of interest and these two wanted to rely on them.

TRIAL II

Investigation of the Variation of Salinity of the water in the Thondaimannar Lagoon "Lake" over an year.

Students participated

C. Sivakannan
V. Nadarajah
S. Navaratnavel
R. Ratnagopalan
A. Thangaratnam
S. Raveendran

College : J/Puloly Boys English School, Pt. Pedro
Teacher/Guide K. Ponnampalam Esqr.

Investigation of the variation of salinity of the water in Thondaimannar Lagoon/"Lake" over an year

1. How this project came about:

Two teachers of a school took up the specific study of the life-cycle of prawns in the Thondaimannar Lagoon, as an extension of the Hydro-biological survey programme. Preliminary data regarding the variation of prawn population in the lagoon, over an year was collected and it was found that there was an increase in the prawn population from the month of January and a peak was reached in the month of March. It was also noted that the population of the prawns dwindled from June and almost disappeared after the month of September. The investigators who were aware of the change of salinity during an year from their earlier participation in the general H. B. Survey, where chemical measurements were taken only twice an year in the months of July and February of each year, thought that the variation in the prawn population may be related to the change in salinity of the lagoon. Hence they decided upon a systematic study of the change in salinity of the lagoon. As one of the investigators being a Chemistry teacher, it was decided to make the Chemistry students of this investigator, to pursue this problem of studying the change in salinity of the lagoon throughout an year, and to integrate this project with the class work.

After consultation with the Hydro-biological Survey Research Council, a plan was drawn out to carry out this special project by the students, The following plan was drawn out and fully discussed with the students to enable them to work on this project.

2.0 Plan of the Project

2.1. Subject area : — Chemistry.

2.2. Aim : — To study the variation in the salinity of the lagoon water throughout the year in order to study the population, distribution and possible migration of prawns.

2.3 Working of the project: —

2.31. Samples of water to be taken from January to December of the year, during the first week of each month.

2.32. The samples of water to be taken at a depth of two feet from the surface.

2.33. The samples of water to be taken at Thondaimannar, Vallai, and Nagarkovil at points to be indicated by the investigators.

2.34. The method for collection of water will be by employing the " inverted bottle method ". (Refer Field Work Guide)

2.35. The quantity of water to be collected from each working point will be one pint.

2.36. Halide content (salinity) to be determined by titration of the water sample against standard silver nitrate solution.

2.37. The result of the analysis to be made available to the investigators before the second week of each month.

2.38. Collection and analysis of water from each station to be entrusted to two students from G. C. E. "O" level.

2.39. The results of the analysis to be presented to the other students of the class for discussion.

2.310. Other members of the class to help the students doing the project occasionally.

2.311. Any interesting points arising out of these discussions to be noted by the teacher in charge and reported to the other members of the Hydrobiological survey research Council.

2.4 Registration of the project with the Hydrobiological Survey Research Council.

The project is to be registered with the Hydrobiological Survey Research Council. The following details about the project is to be given to the Research Council while applying for registration.

(a) Name of school of the participating students:—

(b) Name / Names of the member / members of the Staff in charge:—

(c) Name / Names of student / students participating:—

(d) Level of students:—

(e) Nature of project:—

(f) Period required for completion of the project:—

(g) Nature of aid required from the Research Council:—

2.5 Duties of the Teacher / Teachers in charge of the project.

2.51. He / She / They should not directly participate, but at the same time be responsible for the accuracy of the results of the project.

2.52. He / She / They should not curtail the free thinking of the students, but direct them towards the main objectives of the project.

2.53. He / She / They should present either personally or through the secretary of the Research Council, a progress report about the project every month at the Research Council Meeting.

2.54. Any problems regarding equipments chemicals etc. can be taken up by the teacher / teachers with the person in charge of the Central Office of the Research Council at Nelliaddy M. M. V., Karaveddy.

2.56 The teacher/teachers must continuously assess the work of the students on a five point scale (Refer Assessment) and must give a final grading like A, B, C. D or E to the work of participating student/students. If the teacher finds that the work of a particular student is unsatisfactory he can discontinue the stndent from the project.

2 6 Scheme for Assessment of a Project; -

The students' project is to be assessed on the following lines:- Five marks to be allocated to each one of the following aspect of the project.

(a) Record of data
(b) Background knowledge of participants
(c) Originality of approach
(d) Labour involved in the project
(e) Observations made by the teacher during the course of the project
(f) Final write up

Each of the above aspect to be evaluated on a five point scale and the total out of the maximum marks of thirty is to be assigned to each student. From the raw marks scored by the student the grade for his working is then to be assigned according to the following scheme.

		For the Project	For Each Aspect of Project
Distinction	(A)	23 — 30	5
Good Credit	(B)	20 — 22	4
Credit	(C)	15 — 19	3
Pass	(D)	8 — 15	2
Weak Pass	(E)	1 — 7	1

3. Progress made in the projects.

From January 1968, three groups of students each group consisting of two students, collected samples of water from the

three stations along the Lagoon, assigned to them, and carried out the analysis for chlorinity in the School's Chemistry laboratory during their free periods. These students had earlier experience of this work as they had participated in the Hydrobiological Survey, collecting chemical data. Hence they carried out these analysis fairly accurately. As the stations from which samples were collected were far away from the School, each station being about 8 — 9 miles from the school, the students collected the water samples on a poya day (1st day of a week like Sunday) and brought the samples to the school for analysis on the post poya day. Hence much labour was involved in collecting their water samples. The students were very regular and systematic and entered their data truly and correctly. These results were also discussed with the other students of the class in which these students were studying. The results were also reported to the Hydrobiological Survey Research Council. The project study went on smoothly for six months. But from July the work could not be carried out successfully because some of the students who participated left school to join other schools. The student participants of the projects were selected from G. C. E. (A. L.) 1st year. Hence after the G. C. E. (O. L.) results some of the students left school. (From this experience we feel that the projects should be assigned to second year students so that there is normally no chance of a participant leaving school.

The work that was carried out up to July by the different students were compiled and it produced some significant results. The results are reproduced below. The assessments made on these students are also given below.

Assessment: (according to scheme of assessment as given in the plan of the project)

Names of Participants	*Raw Marks*	*Grade*
C. Sivakannan	20	B
V. Nadarajah	20	B
S. Navaratnavel	16	C
R. Ratnagopalan	18	C
A. Thangaratnam	20	B
S. Raveendran	16	C

Report by the Participants

Aim : — To study the variation if any, in the salinity of water at three points along the Thondaimannar Lagoon. The working points being the stations at Nagarkovil, Vallai and Thondaimannar where the bi-annual Hydro-biological survey is being carried out.

Planning :— A plan drawn out by our chemistry teacher in consultation with the Hydro-biological Survey Research Council was presented to us by the teacher and the plan was discussed at the beginning of the year in our class. (G. C. E. A. L. 1st year) six of us volunteered to take part in this project.

Working :— The six of us divided ourselves into three groups of two each and each group took the work of collecting water samples at Nagar kovil, Vallai and Thondaimannar respectively, every month and determining the salinity of the water samples in the school chemistry laboratory during our free periods.

Each of our group visited the working point assigned to us on the last poya day of each month, collected samples of water by the inverted bottle method and brought the collected water samples to the school laboratory for chemical analysis. The salinity was determined by the titration of the water samples against standard silver nitrate and results were calculated and handed over to our chemistry teacher.

We could work systematically only for the first six months as our work got disorganised after the publication of the G. C. E. (O. L,) results. We are presenting the variation in salinity of the lagoon water from January to December in the form of a graph, of only one station.

Conclusion:—

We find that during every month, salinity is greatest at Thondaimannar, less at Vallai and least at Nagar kovil. There is a gradual increase in salinity in all these three stations from January to June.

Comments: –

In the light of the experience gained in the above trial, the following comments could be made for future guidance.

1. The participants became enthusiastic and worked with an aim
2. Their participation, in the project, in no way hindered their co-curricular activities.

3. Regular discussion of the project in the class with non-participants was found to be fruitless as most students were found to be disinterested. Hence the problems encountered in the project need not be discussed regularly (once a week) in the class, but be discussed in special classes.

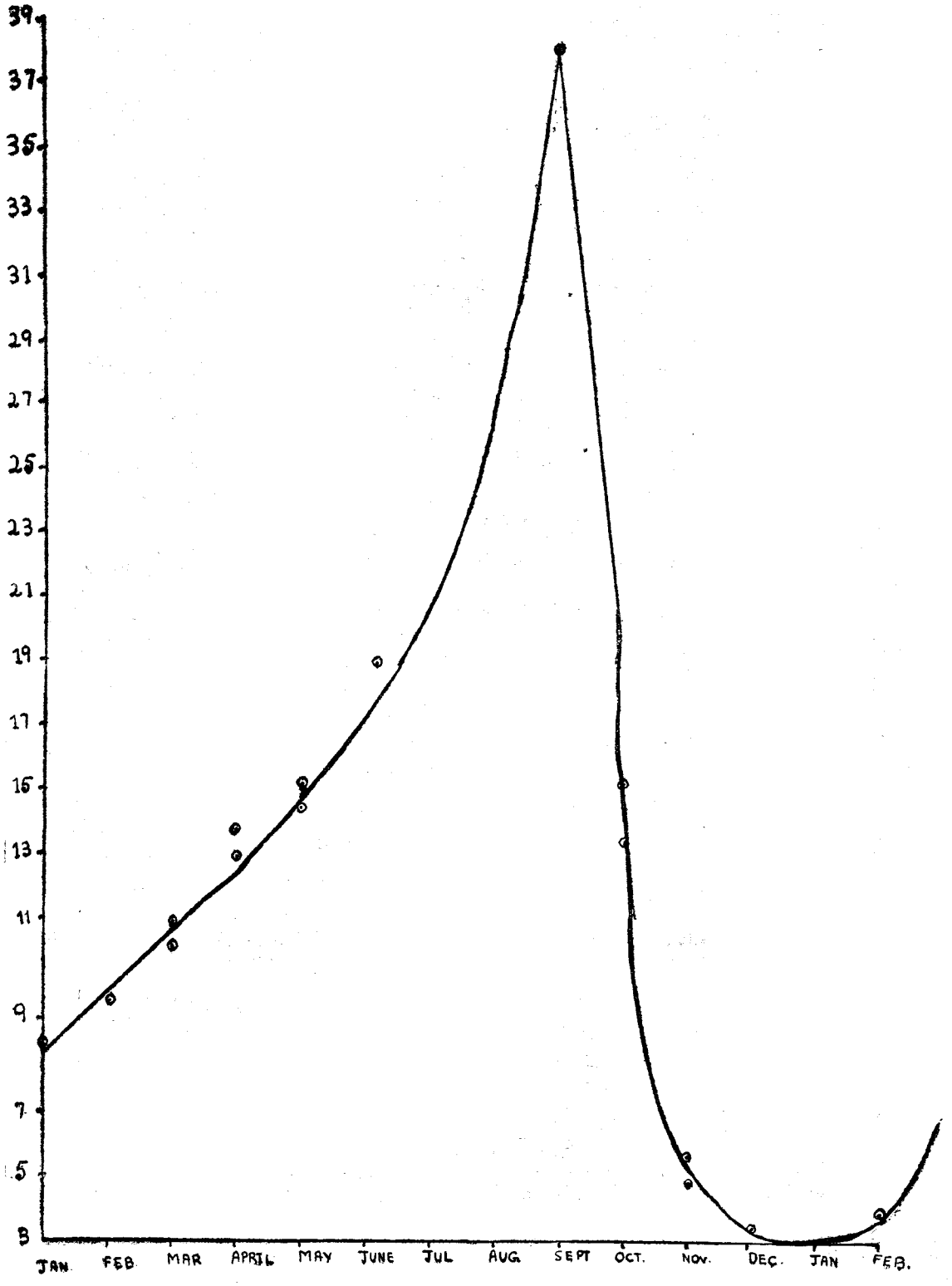
4. Hydro-biological survey Research Council's library was found to be useful in procuring reference material for the participants.

5. Discussions of the project with the other members of the Hydro-biological Survey Research Council proved useful in obtaining very valuable advice in planning the project.

6. Selecting a project, the results of which could be made use of for the improvement of the community aroused more responsive interest among the participants.

7. There is a tendency for the students to misplace the data. Hence special files containing data sheets etc. and cupboards should be provided to the participants at the school.

8. As every project involves some kind of labour, marks cannot be seperately assigned for the labour involved in the project. But labour can be considered during assessment by holding an interview after the final write up is submitted for evaluation.



Halide Concentration in thousands (Parts per million against month—

SECTION : IV

Brief Accounts of some of the projects worked

In this section are included the final write up of some student projects worked to completion. They were all presented at the Science Congress organised by theN. P. S. T. A. We regret very much that we are unable to publish all the write up for want of space.

1. **Project:**— The extent of colonisation and survival in an artificial fresh water pond.

Students Engaged :— S. Gunanayagam
V. Vasanthakumar
S. Sivachandran

College :— Hartley College. Point Pedro

Academic Level :— G. C. E. O/L

Method :— Introducing plants and animals into the pond, and observing their fate from time to time up to a period of two years,

An investigation was done in an artificial pond dug in August 1962, in the college premises. The pond is a circular one of radius 9'.9" and the depth being 1'.5" at the circumference and gradually deepening to 1'.7" towards the centre. At the Centre lies a deeper pit of radius 2'.3" and depth 3'.4", where a fountain is fixed. The sides are are cemented. The pond was filled with well water, and the level was maintained by the fountain.

The temperature of the water rose from 8 A.M. to 2 P.M. and fell from 3 P.M. The average temperature chart read 8 A M — 27.5°c; 11 A M — 30.5°c; 1 P M — 32.25°c; 4 P M — 31.75°c 7 P M — 29.0'c.

The p H of the water was 7.4 on average.

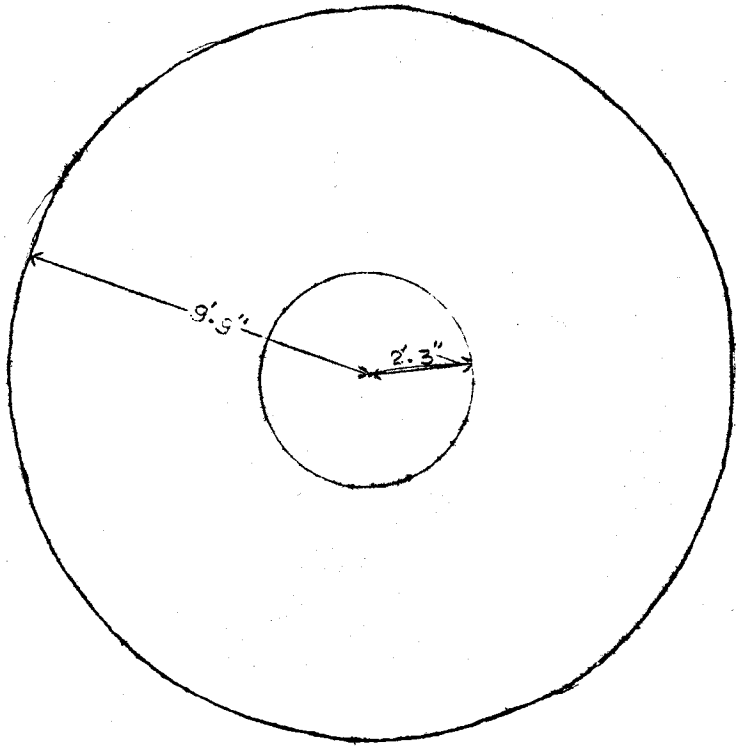
	TYPES	DESCRIPTION	WHEN INTRODUCED	OBSERVATION AT THE END OF TWO YEARS
1.	Bithynia inconspicua	Mollusc with smooth bulbous shell with 3 whorls. Length about 5 m. m.	Oct. 1962	(Aug. 1964) Survived
2.	Trumpet Snail	Mollusc: — Usually found in slow running waters. Shell shiny with four whorls.	Oct. 1962	Survived
3.	Bithynia Sp.	Mollusc: — Greenish brown shell, usually met with in still & slow running waters.	Oct. 1962	Survived
4.	Pond Snail	Mollusc: — Small, Smooth, brown shell—turret shaped with eight whorls.	Oct. 1962	Survived
5.	Melanoides tuberculata	Mollusc: — Rough shell, Conical with eight whorls.	Oct. 1962	Survived
6.	Cardinal nitotica (Prawn)	Arthropod:— Eight segmented animal with prominent eyes.	Oct. 1962	Survived
7.	Panchax panchax blochii	Fish:— Length about 1 inch; Transparent body.	Oct, 1962	Survived
8.	Ptilomera cingalensis	Insect:— Ist pair of legs directed Anteriorly & the 2nd & 3rd pairs directed posteriorly.	———	Seen (Colonised)
9.	Cybister confusus	Insect:— Water-beetle length about 4 cm. 3rd pair of legs foliaceous.	———	Adults & Larva Seen (Colonised)
10.	Dragon-Fly nymphs	Insect:— Larvae with masks, 3 pairs of legs & wing buds.	———	Seen in group. (Colonised)
11.	Water bug / Scorpion	Insect:— Fore legs predaceous–Siphon for respiration.	———	Observed
12.	Ranatra sp.	Insect:— " Water Stick " 1½" long.	———	Seen in plenty

13.	Damsel flies-Nymphs	Insect:– Small, thin & segmented body.	———	Seen in abundance
14.	Gerris adelaidis	Insect:– Pond skater — Plankton 1.5 cm. long rust brown in colour.	———	Seen
15.	Chara	Green alga with linear & brittle leaves, Submerged attached to bottom by roots from central axis.	Sept. 1962	Survived
16.	Scripus	Floating plant with branched stem and spindle shaped leaves.	Sept. 1962	Survived
17.	Salvinia	Floating plant – Of three leaves of a node one acts as a root — spread by fragmentation.	Sept. 1962	Flourished
18.	Valisneria	Submerged plant with greenish yellow linear leaves.	Sept. 1962	Survived
19.	Spirogyra	Floating alga– Thread like plant with row of cells.	Sept. 1962	Survived
20.	Water Lily	Rhizomed plant – loses leaves in dry seasons.	Oct. 1962	Always seen
21.	Snow flake	Plant with circular leaves, and white flowers.	Sept. 1962	Survived
22.	Pistia	Floating plant with a condensed stem and flat leaves. Roots balancing.	Sept. 1962	Perished in about two weeks
23.	Oedogonium	Alga — filament with just a row of cells.	Sept. 1962	Perished within a month
24.	Water wort	A creeper with spoon shaped leaves of sessile flowers.	Sept. 1962	Perished within a month
25.	Portuluca	Herb with long greenish yellow leaves that store water.	Sept. 1962	Perished within a week
26.	Hydrilla	Submerged plant with long slender stem, leaves linear & serrated, in whorls of four or five.	Sept. 1962	Perished within two weeks

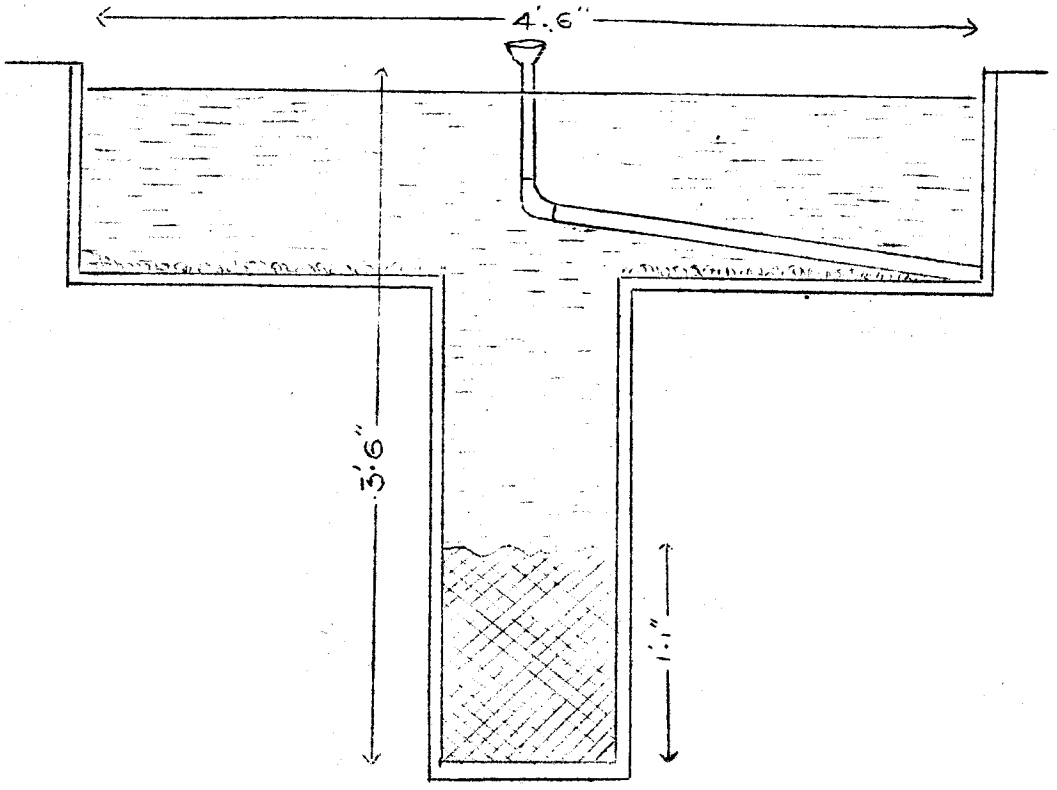
Of the fourteen animals found in the pond in August 1964, seven were colonised forms, and the other seven were introduced forms. All the plants observed were only the introduced varieties. Out of the twelve varieties introduced, only seven survived. The plants that perished, were reintroduced, and they were again found perished. For reasons that we are unaware of, some common pond plants like Pistia did not survive.

From the above we may say that the insects are quick in colonising new environments. And every fresh water plant is not capable of surviving under alien conditions.

POND



INNER ONE IN V. SECTION



2. *Project:*— **HOME-MADE EPISCOPE**

Students Engaged:— V. Yogaanandan
N. Anandarajah

College:— American Mission College;
Uduppiddy

Academic Level:— G. C. E. A/L.

The main aim of this project is to construct an inexpensive apparatus, using as far as possible the materials available at home. The apparatus can be used in places with Electric supply, and where electricity is not available. When electricity is available a 200 watt lamp can be made use of, and when a car battery is used as the current source a 6 Volt, 46 Watt can be made use of.

In constructing the apparatus we came across many practical problems. The first problem was to make a suitable lamp base for the projecting lamp. For that a wooden board was taken and a circular wooden block with two small wooden blocks with grooves were fixed. This served as the lamp holder. FIG 1.

Since the lamp used was a powerful one, large amount of heat was produced. In the commercial projectors, ventilating devices, as blower cooled or fan cooled is used to minimise the heat. In our apparatus, a simple circulation of air was set up by punching holes on the upper side of the outer tin case.

The condenser should be of a short focal length. In our apparatus we made use of fused empty electric bulb filled with water. When this empty bulb was positioned any heat or light emitted by the projecting lamp could reach the film only after travelling through this bulb, and while doing so, the heat would be absorbed by the water. There were also two concave surfaces of glass bounding water in between them, making a complex convex lens of glass and water. Filling the bulb with water is difficult; but we drilled a hole at the bottom of fused bulb, and filled in through it.

The commercial 35 m. m. film strips can be used. The projector may further be modified to project inexpensive improvised

film strips and slides. The improvised film strips consist of the over exposed film negatives, biscuit wrappers or some semi-transluscent paper with drawings made by an ordinary pen. To mount the film and to rotate it while the apparatus worked, we improvised an arrangement indicated in Fig. 2.

To obtain a clear image there should be a clear screen. We have tried with the following screens.

1. Crystalline surfaces : Here the particles reflected the light well. The picture had to be viewed through a narrow angle near the normal. When we viewed from points away from normal, the intensity of the picture fell.

2. Metallic surfaces like aluminium. This gave more brilliance but dropped rapidly at wider angle of viewing.

3. Mat Screens:— We used "Johnsons White" to paint. Here the brilliance of the picture slightly decreased but it was possible to look from wider angles as shown in fig. 3.

We fixed a black boarder round it about 4" wide, and the picture was distinctly seen.

The size of the final image falling on the screen is determined by the focal length of the convex lens. We experimented with lenses of focal lengths 3"; 1.5" and 1", and it was found that the size of the picture decreased with increasing focal lengths. We also found that the size of the picture varied with the distance between the screen end the projector, and the type of lens used,

PICTURE SIZE	FOCAL LENGTH	DISTANCE BETWEEN PROJECTOR AND SCREEN
3'.4"	2	4'.6"
3'.4"	3	7'.
3'.4"	6	14'.6"

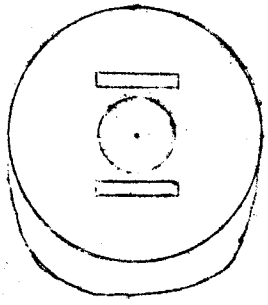


FIG 1

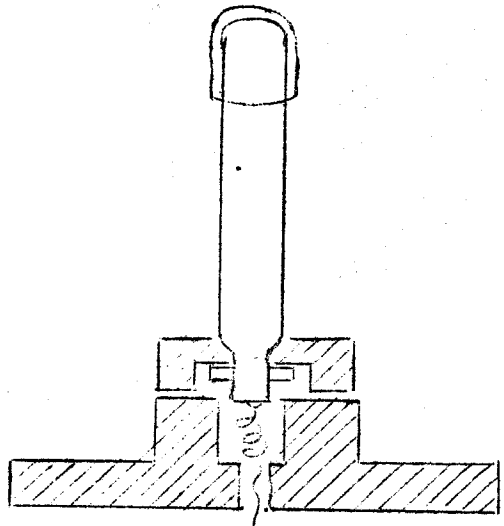


FIG. 2

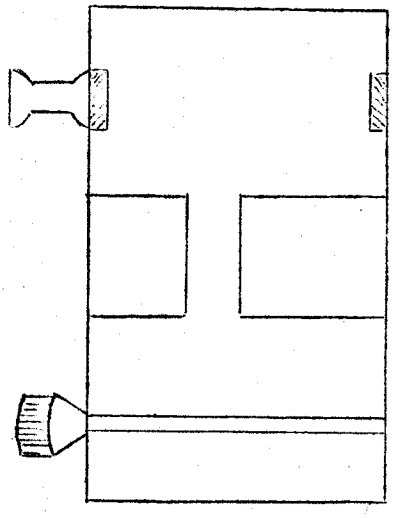
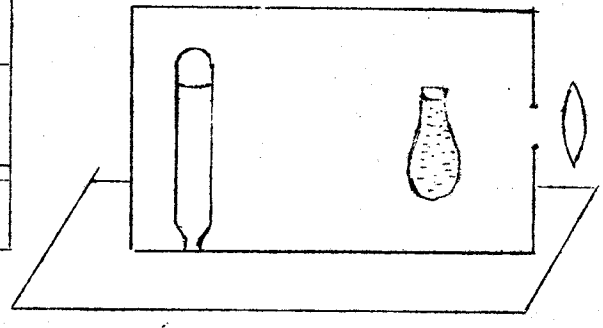
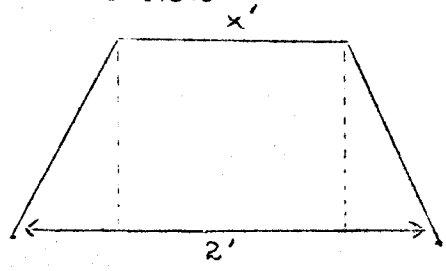
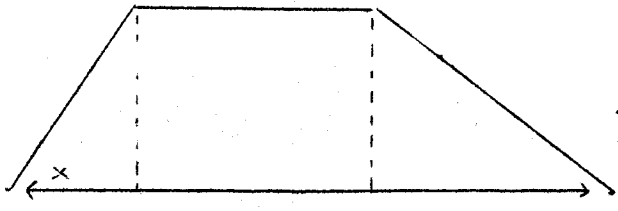


FIG 3



Set in V. Section





. Viewing positions.

3. *Project:*— **HETEROPHYLLY**

Students engaged:— Neelalosany Veluppillai
Kamalaranee Selvadurai

College :— Nelliaddy M. M. V.

Academic Level :— G. C. E. (A. L.)

When leaves of different types are seen on one and the same plant, the phenomenon is termed heterophylly. Usually, when we think of heterophylly, the habits of aquatics like Sagitaria, Myriophyllum, Limnophila, Trapa etc. pass through our mind. But heterophylly is not so uncommon. It is very common, and if we include leaves with the various categories of bracts, cataphylls, stipules ligules, etc, we might even consider heterophylly as a universal rule.

In nature, one might say that "no two living beings are alike." And as regards the leaves of plants, we may find that no two leaves of one and the same plant are alike. There will be a difference, a major or a minor one, in the general shape of the leaf, in the thickness of the leaf, in leaf area, in the thickness or length of the petiole, in the number and position of veins and veinlets, in the angle of the leaf apex. But for the present let us consider the more obvious differences; differences that are easily seen without any close scrutiny of leaves and for the sake of clarity and convenience, we will consider the phenomenon of heterophylly, under these different heads. Habitual Heterophylly, Developmental Heterophylly, Environmental Heterophylly, Seasonal Heterophylly, Anisophylly and leaf mosaic arrangement.

Habitual Heterophylly

In some plants leaves of different sizes, and to a less extent leaves of different shapes are met with. This type of formation involves no functional significance. In Vernonia, Gynandropsis, Pentaphylla, Acalypha indica, Cleome viscosa, leaves of different sizes are seen. In Bryophyllum pinnatum, simple, lobed and compound leaves may be seen. Lobed and compound leaves are of pinnate type. In mulberry (Morus indica) simple and variously lobed leaves are met with. The lobed leaves may be symmetrical or asymmetrical. In cotton (Gossypium herbaceum), bengal rose (Hibiscus mutabilis) Tapioca (Manihot utilissima), castor (Ricinus communis) and the like, the number of lobes are not always the same in different leaves of the same plant. In passion flower (Passiflora foetida), as in mulberry, simple and variously lobed leaves are common. Other examples in this category are Hibiscus micranthus, Tridax procumbens, Argemone mexicana, Jatropha gos-

sypifolia, Atropha curcas, Jak (Artocarpus integrifolia) etc. Various crotons are good examples for habitual heterophylly.

Developmental Heterophylly:

This is the phenomenon where in there is a change from juvenile to mature foliage in the development of the individual. This may indicate some recent changes of foliage type in the history of the race concerned. This adaptation has some functional significance also. In plants like Gynandropsis pentaphylla, Emilia sonchifolia and Cleome viscosa smaller leaves are produced just before the production of flowers so that the flowers are well exposed. In Euphorbia het rophylla and Poinsetti pulcherrima (or Euphorbia pulcherrima) some of the leaves become coloured when the inconspicuous flowers are produced and help in attraction. These leaves are seen immediately below the inflorescences, where the lower leaves have smaller red patches at their bases, on the upper side. The upper leaves have larger red patches and the upper most leaves are smaller and become completely red. In some species of these plants yellow patches are seen.

In Pothos (Many plant) younger leaves are smaller and simple. Adult leaves are larger and may become lobed pinnately. In Eucalyptus, young leaves have larger laminal areas and are thin; where as adult leaves are linear and thick. In Acacia melanoxylon, young plants have compound leaves, where the transformation of the petiole into a phyllode is not seen. At a later stage leaves are produced with slightly flattened petioles; still later compound leaves with fully formed phyllodes; later still phyllodes with reduced compound leaves; and finally phyllodes alone. In beans, peas, grams and many other plants belonging to family Leguminosae, the first pair of leaves are simple (not the cotyledons) where as the leaves that are produced later are compound. In most palms also, in young plants the leaves are simple and in adult plants the leaves are compound. In some the leaves become variously lobed. Examples are the Coconut palm, the Palmyrah palm, the Kithul palm, the Indian and Ceylon date palms, the Date palm, Fan palms, Ornamental palms etc.

Environmental Heterophylly:

Here the phenomenon of heterophylly is conditioned by environmental factors. In dicotyledonous aquatics the submerged leaves become dissected and in the monocotyledonous aquatics the submerged leaves are linear. In Sagittaria the floating leaves are broad and sagitate with long petioles where as the submerged leaves are ribbon shaped, long and narrower. In Myriophyllum, Limno-

phylla heterophylla, Trapa etc. the aerial and floating leaves are broad; where as the submerged leaves are dissected. In Lotus the aerial leaves are different from the floating leaves.

Seasonal Heterophylly:

When the production of different types of leaves correspond to the changes in the seasons it is said to be seasonal heterophylly. In Rhododendron, during certain seasons, when the conditions are not very favourable, only reduced scale leaves are present that protect the buds from injury and cold. On the resumption of the favourable seasons ordinary leaves and flowers are produced. Seasonal heterophylly is common in many plants growing in countries where the climate is temperate.

Functional or adaptational Heterophylly :

When leaves are modified to perform various other functions, it may be noticed that there are various gradations from the normal leaf to the completely modified leaf. For example in Nepenthes, Venus flytrap, Utricularia and other insectivorous plants the leaves are variously modified for the capture of insects. It will be seen that all the leaves do not become modified. For example in Nepenthes a pitcher may be present or absent; in Venus' flytrap the trap may be formed or not; in Utricularia all the leaf segments are not modified to form bladders. Similarly in Gloriosa superba the leaves may or may not end in tendrils. Similax may or may not have the pair of tendrils in relation with each leaf. These differences result in heterophylly,

Anisophylly:

In plants where the leaves are opposite and if each pair of leaves are alike in all respects they are said to be isophyllous. But it is often noticed, that in some plants, of each pair of leaves one is smaller than the other. Usually the upper row of leaves are smaller and the lower row of leaves are larger in branches which are horizontal. Thus the lower leaves are not shaded by the upper leaves. This phenomenon is defined as anisophylly a stem short of or rather towards heterophylly.

Leaf Mosaic Arrangement:

This arrangement provides all the leaves of a plant to get enough sunlight. For example in Acalypha indica, Physalis, and other similar plants, it is noticed that the upper leaves are smaller with shorter petioles where as the lower leaves are larger with longer petioles, resulting in leaf mosaic arrangement. That is the leaves are unlike, If all the leaves are alike, leaf mosaic arrangement is not possible.

From these observations we may come to the conclusion that heterophylly is a more common feature.

4. *Project:*— SOME FIELD OBSERVATIONS MADE

Students engaged:— Anandajayasekaram
Thangavadivelu

College:— Nelliaddy M. M. V.

AcademicLevel:— G. C. E. A. L.

In the course of our field work we made some observations and we would like to present them to you. Our observations are multifarious without any correlation between one another, and we have categorized them to some extent under different heads. Hence the general heading. "Some field observations".

4.1 Hooks in Quisqualis:- Hooks are seen in Quisqualis and we thought of studving the homology of these structures. Our observations brought to light the fact that the hooks are derived from a portion of the petiole. In Quisqualis some leaves have short petioles, whereas some have slightly longer petioles. In the former the abscission layer is formed at the base of the petiole so that these leaves fall off completely. But in the latter the abscission layer is formed towards the base of the leaf blade, and not the petiole, so that when these leaves fall off a portion of the petiole remains on the stem. This portion becomes woody and gets transformed into a hook.

4.2 Deep feeding roots of Pavonia hastata:- During the dry months, when conditions are not favourable for plant life, when most weeds wilts under the hot sun and most of them die off, we discovered that Pavonia hastata is not affected by heat, and shows no wilting. On examining the roots we discovered that these plants have very deep feeding roots, some roots extending to a depth of 9 to 10 feet or even more. This is significant in comparison to the size of the plant which is a herb, growing to a height of a foot, or slightly more or less. During the dry season, when other plants die off, this plant gets a supply of water from the deeper layers of the soil. Of course it has a number of xerophytic adaptations also in addition.

4.3 Origin of lobed and compound leaves:- A lobed leaf is one where the lamina is cut incompletely. And in a compound leaf the lamina is cut into separate leaflets. In some plants the origin of these lobed and compound leaves may be noticed. In Bryophyllum simple lobed and compound leaves are met

within one and the same plant. When the lobed leaves are scrutinised, various gradations in the sizes of the leaves are observed, leading towards a compound nature. In young palm, leaves are simple, whereas in adults they are either lobed or compound. Here the simple leaves became compound due to the death of a few rows of cells, which are seen in the form of long threads, in freshly opened leaves (மட்டை நார்). In Jatropha multifida when the plants are young, the leaves resemble the leaves of papaw but in adult plants the leaves became more and more dissected resulting in a reduction of the laminal area. In mulberry and Passiflora simple and variously lobed leaves are seen. A gradation is seen in the formation of the lobes.

Non Prickly pear:- In Prickly pear the axillary buds are modified into thorns and the leaves and stipules of the axillary buds are modified into spines. Hence, as the name implies it is prickly in nature. But in our College botanical garden we have a species of prickly pear where the thorns and spines are absent; and therefore is non prickly in nature. So much so we have christened it as "Non Prickly Pear".

4.4 Convergence in Evolution or adaptative convergence :- Diverse plants belonging to different families, living under the same environments usually resemble each other. These plants faced with the same environmental conditions get adapted to these conditions by having similar modifications and thus get evolved in the same lines. This is said to be adaptive convergence. We will consider a few types of plants, belonging to different families and resembiing each other to some extent in their habits. In plants like Eurrya japanica (Euphorbiacea) Plumeria (apocynaceae), calotropis (asclepidaceae) and Bryophyllum (Crassulaceae) leaves are broad and thick with similar adaptive features. These plants contains either latex or mucilage. Euphorbia tirucalli (Euphorbiaceae), Russelia juncea (scrophulariaceae) Dregia (asclepidaceae குறிஞ்சா) Ceropegia nilotika (உப்பிலிக்கொடி asclepidaceae) Rhipsalis cassytha (cactaceae) and casurina (casurinae) resemble each other to a very great extent. They have reduced leaves and in their stems contain either latex or mucilage. Stem is a cladode, rounded and reed like. Branching is often multifarious. In Euphorbia antigonum (Euphorbiaceae) Caralluma (asclepidaceae).

Circus peruvianous (cactaceae) and Vitis quadrangularis (ampelidae) stems are angular with four or more ridges. Leaves are reduced (except in cissus) and absent in mature shoots. Stem is a cladode and contains either mucilage or latex. Vegitative propagation from stem cutting is possible in all these cases. Coccoloba or Muehlenbeckia. (Polygonaceae), Opuntia (cactaceae), Epiphyllum (cactaceae) and Asparagus falcatus (Liliaceae) have flat ribbon shaped or leaf like cladodes. Leaves are reduced or absent. Stem contains mucilage in all cases. All the above cases have xerophytic adaptations.

4.5 Divergence in evolution or adaptive radiation :- The above examples may be considered for adaptive radiation also. For example if we consider a few types of plants belonging to the family, Euphorbiaceae we find that they have different adaptations and belong to different categories. Thus Eurrya japanica Euphorbia tirucalli, and Euphorbia antigonum do not resemble each other. Similarly Calotropis, and Caralluma differ from each other. Even though these plants are faced with the same environmental features, they become adapted in different lines showing divergence in evolution. Divergence is also possible when the same group of plants are faced with different environments. Thus examples may be seen of plants that are epiphytes, parasites, xerophytes, hydrophytes, halophytes, all belonging to the same family.

If we consider a single plant showing ecological variations, we may consider Lantana a plant that is common throughout our island. In the dry zone it is a small shrub with small leaves and in the dry reason very few leaves are seen. As we proceed towards the wet zone low country or hill country variation undergone by this plant are easily noticeable. Taller plants will be seen, with larger leaves in greater numbers. Reasons are obvious. In the dry zone transpiration has to be minimised, whereas in the wet zone transpiration has to be advanced. Therefore plants here have smaller leaves, and plants in the wet zone have larger leaves, and the leaf area for transpiration is affected accordingly.

5. *Project:*— **SOME BIRDS AND THEIR WAYS**

Student engaged:— P. Gopalakrishnakone

College:— Hartley College

Academic Level:— G. C. E. A/L.

We have all seen bird's nest and wondered at the pretty cup shaped cradles in which birds put their precious eggs. They are neat and beautifully made. These nests differ very much from one species to another.

Different birds live in different types of localities. If we go to sea shores we can see Gulls and Terns. If we go to the ponds and streams we can see King Fishers, Cranes and Pelicans.

Most kinds of birds feed on seeds, fruits, insects and worms. But some kinds hunt small animals and others, small birds. They are called birds of Prey.

If you peep into a bird's nest you can see eggs lying there. They are beautifully mottled and marked and are narrower at one end than the other. If all the eggs were round they would not fit together in the cup shaped nest. The mother bird places all the eggs so that the narrower end points towards the centre. Thus they take up little room and she can brood over all the cluster at once and keep them warm.

In one occasion I turned two of her eggs in the wrong position and when the mother bird returned she moved them to the right position.

The noise of many birds seems melodius to us. That is why it is called song. We do not know whether birds themselves consider their song sweet although we believe they do so.

If we continue to watch a bird which is singing every day in the morning ..... Suddenly one day there is no singing of the bird. It has not left but since our last visit, a female has arrived and our male is mated. The sudden change in its behaviour is not accidental. It is a rule in many species. Eg. Cuckoo bird.

The song of Wood pecker is of different type. It drums and probably attracts the female by this instrumental music. Once I made a little instrument out of an old alarm clock which imitates the drumming and I placed it near the locality where female wood peckers lived. I was surprised to see many wood peckers were

attracted. If we tape record the bird's songs and played it in the suitable habitat in spring we would get surprising results. The songs serves more than one purpose, such as to attract females and keeping the males apart.

Birds build nests and lay eggs inside it. The outer covering of nests was built by the males and the inner side was built by the female birds. The neatness of the nest it partly because the bird tucks in each straw or twig, leaf or hair separately. When a bird has built her nest she gets into it and renders the inside smooth and round by pressing her breast against the sides. Thus she makes it cup shaped.

Birds use all kinds of things probably the material that lies nearest to hand. The Robin uses the dead leaves around her nesting site, the sea birds use the sea weeds. But all the birds of the same kind make the same sort of nest, that is all crows for instant makes smilar nests of twigs. King Fishers put the nests at the end of the tunnels in the river bank.

A strange nest was once made by a crow which lived near a bus-stand. She found heaps of old wire and built her nest of that; but it must have been uncomfortable. Black Backed Robin (Karikuruvi) often put her nest in curious places. It builds its nest in anything that belong to man such as old boots, old sauce pans etc. Once a pair was found in their nest inside an empty coconut shell.

Sparrows (Adai Kallà Kuruvi) sometimes breed in street lamps and letter boxes. The construction of Weaver Bird's nest shows great skill. The nest is flask like. The upper part of it is cone shaped and hangs from a single point. The nest of a sun bird (a small bird which lives on the honey of flowers) is a beautiful little pear shaped structure hanging from the twig.

Some birds build their nests in tree trunks by making holes in it eg. Wood Pecker, Parrot, Mynah and Barbet (Kukkuruvan). Posts on which cows rub themselves are always visited by the birds and every feather is taken and woven into a nest. Most nests are made as I said before of materials that lie close at hand. This, sometimes lead to funny results.

A little bird once nested near a temple in which festivals were held. Many coloured papers and tissues lay on the ground near by and the bird used these materials for nesting. As a result of this so many people discovered the nest and stare at it so hard.

If we peep into the bird's nest we can see eggs lying there They are brightly coloured with spots. There is usually a reason for every curious thing in the world of nature. The eggs of some birds are coloured because a pure white egg in a nest built among green leaves would be very easily seen. So birds camouflage their eggs. Birds like Stone Plover (a bird which lives along the sea cost) lay sandy or stone coloured eggs speckled just like the shingle on which they are laid. Thus they are almost impossible to see. The author of 'Birds of Ceylon' says " The eggs are so obliterately coloured; that unless the brooding female is seen to. live them, they can be discovered only with the greatest difficulty. "

Birds that put their eggs in the darkness of tunnels or holes, need not have protective colours. So their colours are usually white. The eggs of King Fishers, parrots, Barbets and wood peckers are white in colour. The colour of Cuckoo bird's egg (Koel) and Crow's egg are alike because the Lazy Cuckoo bird lays it eggs in the nest of crow.

Bird's eggs can develop only if they are at a constant and a fairly high temperature about that of the bird's body. All birds living in our area keep the eggs at the right temperature by sitting on them (except the lazy cuckoo bird)

When an egg is about to hatch the chick inside by stretching itself repeatedly and slowly turns round making a series of cracks and finally a hole in the shell, and it cracks the shell all the way round and separating a lid from the rest. It then crawls out. When the eggs have hatched the parent may pick up and carry away the empty shell, or it may swallow it in this way recovering parts of calcium it originally put into the egg.

When the baby birds are in the nest the parents are very busy. For there are many wide open beaks to feed. Off they go day after day and make hundreds of journeys to find flies, caterpillars and insects of all sorts for their hungry youngsters. When the mother bird arrives at the nest with the caterpillar she sees four or five yellow beaks wide open to receive it. She pops it into the nearest one and off she goes again. Thus it feeds the youngsters.

Once the chicks have got over the young stage and have grown feathers and can flutter their wings, their lessons begin. They have to leave the nursery where they are well fed and protected to go out into the world to learn to look after themselves.

Project 6 : Variation in the heart beat of Toad under different Conditions,

Students engajed : T. Sivanathan
N. Shanmuganathan

College J/Uduppiddy American College.

Academic Level G. C. E. *(A-L)*

வெவ்வேறு சூழ்நிலைகளில் தவளையின் இதயத்துடிப்பை அறிதல்

உபகரணம் அமைத்தல்

உபகரணத்தை அமைப்பதற்கு முதலில் பின்வரும் பிரச்சினைகள் நிவர்த்தி செய்யப்படல் வேண்டும்.

1. இதயத் துடிப்பைப் பலமுறை பெருக்கிக் காட்டக்கூடிய ஓர் பொறிமுறை.
2. உருப் பெருக்கப்பட்ட இதயத்தின் கீழ் அசைவை வரை படமாக மாற்ற ஓர் அசையும் (சுழலும்) தகரப்பேணி அவசியம்
3. வேகம் மாறுது மெதுவாகச் சுழற்சியைத் தரக்கூடிய பொறிமுறை.
4. நுண்ணிய அலகின் அழுத்தம் குறைந்த அசைவையும் வரைபடமாக்கக் கூடிய கடதாசி.
5. காட்டி அலகின் (வரையும்) வரை படமாகும் தன்மை.
6. குறிக்கப்பட்ட நேரத்திற்குத் துடிப்பின் வேகத்தைக் கணிக்கும் பொறி.
7. வரை படம் அழியாமல் இருப்பதற்கு வேண்டிய தடை முறை.

சக்கரங்கள் பொருத்தப்பட்டுள்ள ஒரு மணிக்கூட்டின் உட்பகுதி யுடன் சிறிய மோட்டார் (Motor) ஒன்று இணைக்கப்பட்டது. பின் மணிக்கூட்டின் நேரக் கம்பியுள்ள சக்கரத்தில் ஒரு றீல்கட்டையைப் பொருத்தி ஒரு இரப்பர் வளையத்தினால் மோட்டரின் தண்டுடன் தொடுக் கப்பட்டது.

பின் மணிக் கம்பியின் சக்கரத் தண்டிற்கும் தகரப் பேணிக்கு மிடையில் நூல் வளையமொன்றைப் பூட்டி தகரப்பேணியானது மேலே யும், கீழேயும் தாங்கியினால் பூட்டப்பட்டு அதன் அச்சு செங்குத்தாக அசைவின்றி இணைக்கப்பட்டது. புகை படிந்த தாழ் ஒன்று பேணிமேல் ஒட்டப்பட்டது. மின் கலத்தின் உதவியினால் மோட்டரை இயக்க தகரப் பேணி மிகவும் மெதுவாகச் சுழலும். இது நிற்க, இன்னொரு தாங்கியில்

ஒரு பலகையை இணைத்து அதன் நடுவில் ஒரு போல்றேசரைப் பொருத்தி அதனுள் பொருத்தத் தக்க துவாரமுள்ள ஒரு இரும்பு ஆணியைச் செலுத்தினோம். ஒரு நீண்ட ஈக்குக்குச்சின் முனையில், பட பிலிமிலிருந்து வெட்டப்பட்ட ஒரு கூரான பகுதி இணைக்கப்பட்டது. அவ்வீக்குக் குச்சியைப் போல் றேசரிலுள்ள இரும்பு ஆணியின் துவாரத்தினூடாகச் செலுத்தி அதை நன்கு அசையத்தக்கதாக வைத்து அவ்வாணியை மைய அச்சாகக் கொண்டு குச்சின் ஒரு பகுதியின் நீளத்தை அதிகரித்தும், மறுபகுதியின் நீளத்தைக் குறுக்கியும் விடப்பட்டது. அதாவது தவளையின் இதயத் துடிப்பின் ஒரு சிறு அசைவை மிகவும் பெரிப்பிக்கக்கூடியவகையில் ஆணியை மைய அச்சாகக் கொண்டு குச்சை ஒரு குறிப்பிட்ட விதத்தில் சரிசெய்தோம். இப்பொழுது இக் காட்டி நன்கு அசையத்தக்கதாகவும், இதயத்துடிப்பின் ஒரு சிறு அசைவைப் பெருப்பிக்கக்கூடியதாகவும் இருந்தது. காட்டியின் நடுவில் ஒரு தகரத் துண்டைச் சுற்றினோம். பின் காட்டியின் கீழ் ஒரு செம்புக் கம்பி சுற்றப்பட்ட மெல்லிரும்புத் துண்டைத் தாங்கியுடன் இணைத்து அது காட்டி இணைக்கப்பட்டிருந்த தாங்கியுடன் இணைக்கப்பட்டது. பின் மெல்லிரும்பின்மேல் சுற்றப்பட்டிருந்த செப்புக் கம்பியை ஒரு ஆணிக்கும் மின்கலத்திற்குமாக இணைத்தோம். படத்தில் காட்டப்பட்டுள்ள உபகரணத்தைப் பார்ப்பதன் மூலம் அதன் அமைப்பு இலகுவாகப் புரியும். இப்படியான ஒரு உபகரணத்தையமைத்ததன் மூலம் மேற்கூறிய பிரச்சினைகளை நிவிர்த்தி செய்யக் கூடியதாகவிருந்தது.

வரை படம் எடுக்கும் முறை

இதயத்துடிப்பின் வரைபடம் எடுப்பதற்கு ஒரு தாளின் மீது புகைபிடிக்கப்பட்டது.

தவளையின் தோலையும், உட்புறச் சவ்வுகளையும் அகற்றி, இதயத்தை வெளியே தூக்கிப்பிடித்து, நூலினுல் கட்டப்பட்டிருக்கும் ஒரு மெல்லிய வளைந்த குண்டூசியினுல் இதயத்தின் மேல் தசையில் குற்றி அந்நூலினைக் காட்டியுடன் இணைத்தோம். இதயத்தின் துடிப்பினுல் அசைந்து கொண்டிருக்கும் காட்டியின் நுனியைப் புகை படிந்த தாளில் முட்டச் செய்தோம். பின் ஆணியைப் போட்டபொழுது மின்சாரத்தினுல் மெல்லிரும்பு காந்தமாக, காந்தம் காட்டியைக் கவர, காட்டி அசையாமல் நின்றது. பின் மின்னைச் செலுத்தி மோட்டரைச் சுழலச்செய்யத் தகரம் மெதுவாகச் சுழல ஆரம்பிக்கும். காட்டி அசையாமல் புகைபடிந்த தாளிலே முட்டிக் கொண்டிருந்த படியினுல் தாளில் ஒரு நேர்க்கோடு உண்டாக்கிக்கொண்டு வரும். இப்படி ஒரு சிறு நேர்க்கோடு உண்டாகியவுடன் ஆளியை (Switch)த் தட்டி மின்னை இல்லாமல் செய்தபொழுது மெல்லிரும்பின் காந்த சக்தி

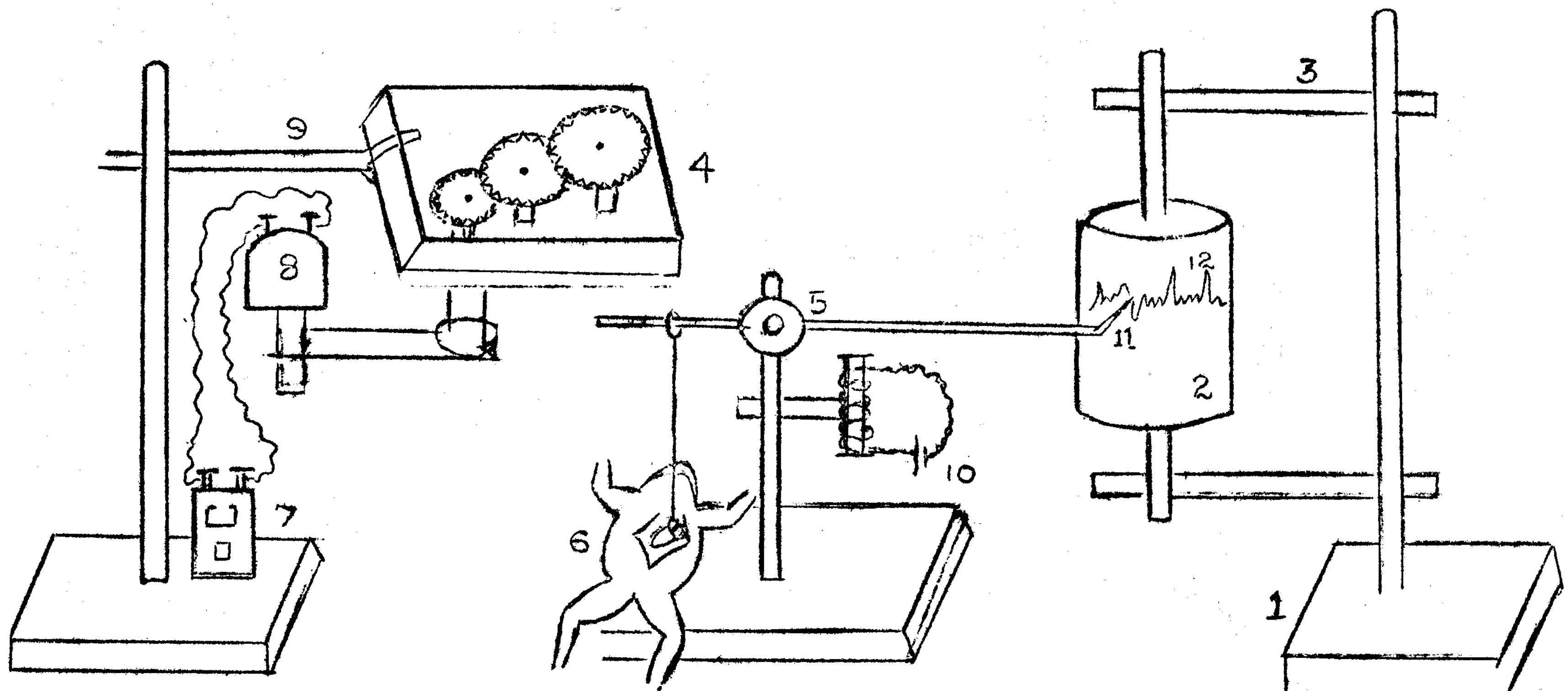
இல்லாமல் போக காட்டி அசையத் தொடங்குகின்றது. ஆணியை அகற்றும் அதே நேரத்தில் நிறுத்தற் கடிகாரத்தையும் ஆரம்பித்து வைப்பதனால் நிறுத்தற் கடிகாரத்தை உபயோகிப்பதன் மூலம் எமக்கு விரும்பிய நேரத்திற்கு இதயத் துடிப்பைக் கணிக்க முடியும். காட்டி இதயத் துடிப்பைப் பதிவு செய்யத் தொடங்கும். இப்படியாக ஒரு குறிக்கப்பட்ட நேரத்திற்கு இதயத்துடிப்பை எடுத்த பின்னர் மறுபடியும் ஆணியை உபயோகித்து மின்னைச் செலுத்தும்போது காட்டி அசையாமல் போக புகை படிந்த தாளில் ஒரு நேர்க்கோடு உண்டாகின்றது.

இதிலிருந்து நாம் நிறுத்தற் கடிகாரத்தில் குறிக்கப்பட்ட நேரத் திற்கு முதல் கோடு ஆரம்பமாகி அதிலிருந்து உண்டாகின்ற இதயத் துடிப்பிலிருந்து அடுத்ததோடு ஆரம்பிக்கும் இடத்தில் முடிவடைகின்ற இதயத்துடிப்பு வரைக்கும் எவ்வளவு துடிப்புகள் என்று எண்ணிக் கணித்துக் கொள்ளலாம். சுருக்கமாகச் சொல்லின் முதல் நேர்க்கோட் டிற்கும் அடுத்த நேர்க்கோட்டிற்கும் இடையில் உள்ள தூரத்தில் செங் குத்துத் தளத்தில் எத்தனை இதயத்துடிப்புக்கள் பதிவு செய்யப்பட்டிருக் கின்றனவோ, அவையே குறிக்கப்பட்ட நேரத்தில் தவக்கையின் இதயத் துடிப்பின் வேகமாகும்.

இப்படியாக முற் கூறியுள்ளபடி அறை வெப்ப நிலையிலுள்ள நீர், 40°Cயில் உள்ள நீர், அதிரலின் ஆகியவற்றைவிட்டு, சூழ்நிலையை மாற்ற இதயத்துடிப்பின் வேகம் கணக்கிடப்பட்டது.

ஆகவே மேற்கூறிய பரிசோதனை வாயிலாகக் கீழ்க் காணும் முடிவு கள் பெறப்பட்டது.

சூழ்நிலைகள்	அடிப்புக்களின் சுருக்கத்தின் எண்ணிக்கை (10 செக்கனுக்கு)	நீளம்
1. சாதாரண நிலை	17	0·26 மி. மீ.
2. அறை வெப்ப நிலையிலுள்ள நீர்	15	0·2 மி. மீ.
3. 40° Cயிலுள்ள நீர்	12	0·13 மி. மீ.
4. அதிரலீன்	7	0·43 மி. மீ.



1
2
3
4
5
6
7
8
9
10
11
12

SECTION V

Some Suggested Projects

Though selection of projects must be left to the Student himself, the Hydro Biological Survey Research Council ventures to list some of the projects that could possibly be worked. The list though inadequate, will serve to direct the willing members "where and how to look for."

1. Life history of Rhinophora mucronata
2. ,, ,, of Avicennia
3. Gases dissolved in the water in Mangrove swamp.
4. An Improvised method of measuring light intensity.
5. Estimating the catch of Prawns every month.
6. Size of Macrones gluio at various regions of the lagoon and the possible causes for their difference
7. Variation in Salinity on either side of the barrage every month.
8. Food & nesting habits of a resident bird of the lagoon.
9. Study of the temperature fluctuation with seasons of the year.
10. Comparing the changes in salinity and hardness of the lagoon water and selected wells around it throughout an year.
11. Trying different strains of paddy on reclaimed soil at Nagarkovil.
12. Do..... Vallai.
13. Collection & identification of the dead molluscan shells of Thondaimannar area.
14. Construction of a Thermister from locally available material.
15. Studying the salinity tolerance of Ostvea sp. found on the sea side of the barrage.
16. Evolving a better technique for estimating the oxygen dissolved in water.
17. Collecting and identifying the coral skeletan found at Thondaimannar area.
18. Making a critical study of the local methods used in Fishing.
19. Extent of influence of plants on the evaporation of water.
20. Collection mounting and identifiction of butterflies that frequent the lagoon area.
21. Devising a turbidity scale based on the amount of total solids in water.

22. Listing the soil organisms in the soil at Nagarkovil.
23. Do at Thondaimannar
24. Do at Vallai.
25. Influence of bridge on plant growth at Vallai.
26. Study of the life history of Oecophilla.
27. Home made Anemometer
28. Construction of an electric water current meter.
29. Studying the development of Chironomid larva found in the lagoon.
30. Variation of hardness and salinity in an aquarium with a known plant and known type & number of fishes.
31. Collection and testing of gases in the marshy soils of Nagarkovil and Anthananthidal.
32. Tolerance of Salicornia to fresh water flooding.
33. Investigating the chemical change that causes the yellowishness in Salicornia and redness in Arthrocnemum.
34. Study on the growth & structure of pneumatophores of Avicennia.
35. Growth of Tilopia in the lagoon.
36. Evaporation rate in relation to wind speed, temperature and humidity.
37. Amphibian distribution along the lagoon.
38. Decline of marine fauna from the lagoon.
39. Estimation of the amount of leaf litter drawn into the soil by the earthworms.
40. Qualitative estimation of the fresh water fauna of the lagoon.
41. Humidity and Temperature effects on the nesting habits of Oecophilla.
42. Colour variation with food in caterpillars.
43. Qualitative estimation of the fresh water plants of the lagoon.
44. Benthic faunal/floral distribution in relation to salinity.
45. Variation of surface tension and viscosity with salinity.
46. Magnetic elements at different places.
47. Xerophytes along the lagoon.

48. Food cycle in the lagoon.
49. Pyramid of life in the lagoon.
50. Distribution of any one fish along the length of the lagoon.

List of Reference

1. Scientific Research in schools, S. M. A. Publication
2. Atputhanathan, M., Kugathasan, K. S. & Gunaratnam, K : Preliminary Observations of Hydrobiological survey of Thondaimannar lagoon (C. A. A. S. Session, 1965-Section D)
3. Project book-Nuffield trial A. Level Biology Project, 1967
4. The teaching of science in secondary schools, S. M. A. Publication.

Appendix I

HYDRO–BIOLOGICAL–SURVEY, RESEARCH COUNCIL

Identification No.	NAME OF THE FISHES திகதி	எண்ணிக்கை	எண்ணிக்கை	மதிப்பீடு செய்பவரின் குறிப்புகள்	For office use only.	
T 1	NEMATOLOSA NASUS கொய் மீன்					
T 2	RASBORA DANDICONIUS					
T 3	PUNTIUS FILAMENTOSUS					
T 4	PUNTIUS SARANA					
T 5	TACHYSURUS CAELATUS					
T 6	MACRONES GULIO சுங்கன்					
T 7	ANGUILLA BICOLOR BICOLOR விலாங்கு					
T 8	ANGUILLA NEBULOS NEBULOSA புள்ளி விலாங்கு					
T 9	TYLOSURUS STRONGILURUS பாம்பு முரல்					
T 10	HYPORHAMPHUS GAIMARDI முரல்					
T 11	PANCHAX PANCHAX BLOCHII					

மதிப்பீடு செய்பவரின் கையொப்பம்:

T/C. C /VVT.
6-4-68.

MEMBERS OF THE
HYDRO-BIOLOGICAL SURVEY RESEARCH COUNCIL—Aug. 1968

1. M. Atputhanathan Convener & Project Officer, Station I
2. K. S. Kugathasan, Project Officer, Station III
3. K. Selvavenayagam, Project Officer, Station II
4. K. Ponnampalam, Secretary-cum-Treasurer, Research Council.
5. K. Chitravadivelu, Project Asst.
6. P. Ganeshamoorthy ,, ,,
7. S. Roy Kanthoraj ,, ,,
8. R. Ponnambalam ,, ,,
9. T. Puthrasingam ,, ,,
10. V. Rajanayagam ,, ,,
11. P. Sabaratnam ,, ,,
12. K. Shanmugasundaram ,, ,,
13. K. Sivapathasundaram ,, ,,
14. N. Sundaramoorthy ,, ,,
15. V. Sundaralingam ,, ,,
16. T. Thamby ,, ,,
17. S. Sathyamoorthy ,, ,,

Participating Schools

1. American Mission College, Uduppiddy
2. Chithambara College, Valvettithurai.
3. Gnanasaria College, Karaveddy.
4. Hartley College, Point-Pedro.
5. Holy Family Convent, Jaffna.
6. Jaffna Central College, Jaffna.
7. Nelliady M. M. V., Karaveddy.
8. Puloly Boys' English School, Point-Pedro.
9. Uduppiddy Girls' High School, Uduppiddy.
10. Urumpirai Hindu College, Urumpirai.
11. Vada-Hindu Girls' College, Point-Pedro.
12. Vaideswara Vidyalayam, Jaffna.
13. Vigneshwara College, Karaveddy.
14. Methodist Girls' High School, Point-Pedro.
15. Thondaimannar M. V., Thondaimannar.
16. Mahajana College, Tellipallai.

BULLETINES OF THE

HYDRO-BIOLOGICAL RESEARCH COUNCIL

(THONDAIMANNAR LAGOON)

OF THE NORTHERN PROVINCE

SCIENCE TEACHERS' ASSOCIATION

1. THE IMPACT OF THE RESEARCH PROGRAMME ON SCIENCE EDUCATION
2. FIELD WORK GUIDE
3. BIRDS OF THE LAGOON
4. 5 YEAR REPORT (1963 through 1967)
5. PRAWNS OF THE LAGOON
6. STUDY OF TWO WORMS
7. MANGROVES OF THE LAGOON
8. CARBON-DIOXIDE & OXYGEN GRADIENT OF THE LAGOON WATER
9. FISHES OF THE LAGOON
10. HYDROLOGICAL PARAMETERS OF THE LAGOON AREA
11. PLANTS OF THE LAGOON AREA
12. STUDENTS' PROJECTS

CENTRAL OFFICE
OF THE RESEARCH COUNCIL
NELLIADY M. M. VIDYALAYAM
KARAVEDDY P. O.
CEYLON.

PRINTED AT THE ASIRVATHAM PRESS, JAFFNA.