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ANNUAL REPORT

INTERNATIONAL CENTRE FOR
DIARRHOEAL DISEASE
RESEARCH BANGLADESH

The *INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH* (ICDDR) is an autonomous, non-profit making organisation for research, education, training and clinical service. It was established in December 1978 as the successor to the Cholera Research Laboratory, which had been established in Bangladesh in 1960.

The mandate of the ICDDR is to undertake and promote research on diarrhoeal diseases and the related subjects of nutrition and fertility, with the aim of preventing and controlling diarrhoeal diseases and improving health care. The ICDDR has also been given the mandate to disseminate knowledge in these fields of research, to provide training to people of all nationalities and to collaborate with other institutions in its fields of research.

The Centre, as it is known, has its headquarters in Dhaka, the capital of Bangladesh, and operates a field station in Matlab Upazila of Chandpur District. The Centre is organised into four scientific divisions: Population Science and Extension, Clinical Sciences, Community Health, and Laboratory Sciences. At the head of each Division is an Associate Director; the Associate Directors are responsible to the Director who in turn answers to an International Board of Trustees consisting of eminent scientists and physicians and representatives of the Government of Bangladesh.

The Centre is funded by organisations and nations which share its concern for the health problems of developing countries. The major donors to the Centre include: Australia, the Aga Khan Foundation, the Arab Gulf Fund, Bangladesh, Belgium, Canada, Denmark, France, the Ford Foundation, the International Development Research Centre, Japan, the Netherlands, Norway, Sweden, Switzerland, Saudi Arabia, the United Nations Capital Development Fund, the United Nations Development Programme, UNICEF, the United Kingdom, the United States, the Wellcome Trust, the World Bank, the World Health Organization and the World University Service of Canada. ■

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The ICDDR publishes a journal, a newsletter, scientific reports, monographs, annotated bibliographies and many other items in the field of diarrhoeal diseases and on related subjects. Details of some of these publications may be found at the end of this report.

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PREFACE

This is the eleventh Annual Report of the International Centre for Diarrhoeal Disease Research (ICDDR), Bangladesh.

This report describes many aspects of the work of the staff of the ICDDR during 1989, including research, support for research and providing health services. The articles published by the Centre's current or former staff and by visiting scientists are also listed here. Many of these articles describe research actually done in previous years and reported in earlier Annual reports.

If you have any comments on this report or would like more information about the ICDDR or the work described here, then please write to the Director at the address given opposite. ■

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DIRECTOR'S INTRODUCTION

The year 1989 was an eventful one characterised by calamitous financial developments, difficulties in the tripartite relationship between the Board of Trustees, the Centre's Management and Donors, a collective effort in the preparation of an institutional strategic plan, and the resignation of Professor Roger Eeckels as Director.

A major donor which has supported the Demographic Surveillance System since 1988 and had concluded a new cooperative agreement for 1989 through 1991, informed the Centre that due to a reduction in its own budget it would be unable to honour the agreement. However the donor agreed to provide support throughout 1989 to allow the Centre to identify an alternative. The Centre's budgetary expectations from some other donors were similarly not met resulting in a potential deficit of considerable magnitude for 1989. These events clearly confirmed the fragile funding arrangements of the Centre. A crisis was averted by strict financial austerity, some increased funding from other donors, and by the resumption as a donor of the Swedish Agency for Research Cooperation with Developing Countries, so that by the end of 1989 the Centre had sustained a negligible deficit of $30,000.

One of the major achievements of 1989 was the preparation of a Strategic Plan for the Centre for 1990 to 1994. The process contributed to a rapprochement between the Board of Trustees, Donors and the Centre's management and led to an improved working relationship. The Plan spelt out the general direction of the research, service and training that the Centre should undertake over the next 5 years and beyond. It was based on an assessment of the problem of diarrhoeal diseases in developing countries and related problem of nutrition and fertility; on priorities for research identified by the Diarrhoeal Disease Control Programme of the World Health

Asem Ansari

The Council of Associate Directors (see page 56) at a recent meeting. From the left: Mr. M.A. Mahbub (Administration and Personnel Division), Dr. Michael Koenig (Population Science and Extension Division), Dr. Saul Tzipori (Laboratory Sciences Division), Dr. Demissie Habte (Director), Mrs. Judith Chowdhury (Minute Secretary), Dr. Dilip Mahalanabis (Clinical Sciences Division), and Dr. A.K.M. Siddique (Community Health Division). Absent: Mr. J. Winkelmann (Finance Division).

Organization and by international institutions of population studies; on the recommendations of the Centre's external reviewers; and finally on past research and on the strengths and advantages of the Centre. The endorsement in principle of the Strategic Plan by both the Board of Trustees and the Donors' Support Group was a highlight of the meeting of the Board and Donors in December 1989.

Three of the scientific divisions were reviewed during 1989: the review of the Laboratory Sciences Division was conducted by the Programme Committee reinforced by external members, while the other two review teams were composed entirely of external members. (The Clinical Sciences Division had been reviewed in 1988.) Considerable changes have taken place for the better in the Laboratory Sciences Division, as well as in other divisions, in response to recommendations proposed by the reviewers.

The terms of reference of the Donors' external review of the Centre were developed during the year with participation of the Centre as well as the Donor community. The review due to be held in March or April 1990, is expected to focus on management and finance.

The Centre's staff have continued with research activities despite financial constraints and the time required to prepare the Strategic Plan and for the External Reviews. Difficulties in filling vacancies in certain key posts, particularly in the Community Health Division, continue to create a major problem. Nevertheless the Centre's performance indicates a creditable achievement.

The near completion of the Matlab treatment and research centre, built with a grant from the United Nations Capital Development Fund, has enabled a transfer of activities from the Upazilla health complex to the new location only a few hundred metres away. It is expected that this will facilitate and promote the expansion of studies in Matlab. In Dhaka the renovation of facilities at the Clinical Research Centre has improved the quality of patient care.

The year was marked also by the departure of Professor Roger Eeckels in July 1989 after four years of dedicated service to the Centre. The new Director took office in August 1989.

What does the future hold for the ICDDR? For several reasons, 1990 may indeed be a decisive year. Some of the basic issues besetting the Centre such as ensuring financial security and stability, will continue to be tackled. Other important tasks will include recruiting competent senior staff, strengthening the training function of the Centre, rationalising the management and staffing structure, and improving public relations activities.

Demissie Habte, Director

WATERY DIARRHOEA

Illness and deaths due to acute watery diarrhoea occur largely because of the loss from the body of water and salts in the stools. For example, *Vibrio cholera* and some strains of *Escherichia coli* produce toxins which cause the cells lining the intestines to secrete water and salts into the gut lumen. The absorptive capacity of the lower gut is overwhelmed so that during severe cholera the stool volume may exceed a litre an hour, although the word "stool" is something of a misnomer. If the losses of water and electrolytes can be replaced and if a balance between intake and losses can be achieved, much of the battle is won: an immune response to the pathogen should develop and the patient will get better within a few days in what is said to be 'self-limiting" diarrhoea. Over the last 20 years the ICDDR and its predecessor, the Cholera Research Laboratory, have been at the forefront of research on treating dehydration, particularly using solutions of salts and sugars given by mouth. Such a means of treating dehydration due to diarrhoea may seem paradoxical, but during acute diarrhoea the gut is still able to absorb considerable volumes of water and dissolved salts as long as simple sugars are present in the gut lumen: the absorption of water is coupled to the uptake of sugar, and as water flows into the gut it drags in salts as well.

Using simple solutions of salts and sugar it is possible to rehydrate by mouth about 90% of patients with diarrhoea, but there are still significant problems. These mainly lie in the fact that oral rehydration solution (ORS) doesn't stop purging or significantly reduce the duration of diarrhoea, two responses to a treatment which are essential if people are to accept ORS as the only treatment they use for themselves or their children. The main thrust of clinical research on ORS is now to develop a solution that will appreciably reduce the stool output in patients suffering from acute watery diarrhoea.

A recent clinical trial conducted at the ICDDR using 90 mmol each of L-alanine and glucose as constituents of ORS has shown a

Azam Ansari

The standard treatment for watery diarrhoea recommended by the World Health Organization is 3.5g sodium chloride, 2.9g tri-sodium citrate, 1.5g of potassium chloride and 20.0g of glucose dissolved in one litre of pure water. At the ICDDR the glucose is replaced by 50g of rice powder which is cooked with a little more than a litre of water (to allow for evapouration) and then the salts are added after it has cooled. This rice-ORS has been shown to be more effective than glucose-ORS and is culturally acceptable in Bangladesh. Infants and young children should be spoon fed.

40% reduction in stool output in severely dehydrated adults and older children suffering from acute diarrhoea. Since L-alanine is quite expensive, another study has begun to see if similar effects on stool output can be achieved by reducing the concentration of L-alanine in ORS by almost half.

Oral rehydration solutions containing alanine
Principal Investigator: F.C. Patra
Funded by: WHO
The aim of this study is to compare the oral rehydration solution recommended by the WHO with two solutions containing either 50 mmol or 90 mmol L-alanine. The glucose and electrolyte composition of the L-alanine solutions are similar to the WHO ORS. By the end of the year 81 of the 240 patients required to do the study had been enrolled and randomly assigned to receive one of the three solutions which are being given in a double-blind fashion. ■

Dehydration and the loss of salts during diarrhoea can lead to an accumulation of acids in the body and a condition called "acidosis". The bicarbonate used in the standard formula of ORS is good at correcting this condition, however, when ORS is prepare din packet form and stored for several months, the bicarbonate tends to react with the sugar present to produce brown furfural compounds. Citrate can replace bicarbonate to correct acidosis and it gives packets of ORS a longer shelf-life, but does it produce an equally effective oral rehydration solution?

A citrate containing oral rehydration solution for treating watery diarrhoea
Principal Investigator: Ramendra N. Mazumder
Funded by: WHO
In this study 180 males aged 8 years and above with acute watery diarrhoea for less than 48 hours were rehydrated intravenously for four hours and randomly assigned to one of two groups. The results of the analysis showed that a significantly smaller volume of stool was passed during the first 24 hours of oral rehydration by the group given ORS containing citrate instead of bicarbonate in the formula. This group also consumed less ORS. After 24 hours the differences were not statistically significant. ■

Many forms of ORS have been developed which use a starchy food as a source of sugars to promote the absorption of water and salts during diarrhoea. A solution based on powdered rice has been shown to be very successful and is used as a standard treatment for people with diarrhoea who attend the Clinical Research Centre of the ICDDR. Staff of the Centre have been providing technical assistance to the Kenyan Medical Research Institute who are studying the efficacy of an oral rehydration solution based on maize, a common staple food in many parts of Africa.

Field comparison of glucose-ORS and a maize-salt solution in rural Kenya
Collaborative investigator: A. Bari
Funded by: Aga Khan Foundation
The objective of the study, which ended during 1989, was to compare the effects of a standard glucose ORS with a solution made from powdered maize and salt. The study was undertaken in Kakamega District in western Kenya; the subjects of the investigation were 4,000 children less than 5 years of age. The treatments were evaluated in terms of their clinical and nutritional impact, and the safety of the experimental solution was also tested. ■

Research at the Centre has shown that the superiority of a formulation of ORS in which rice powder replaces sugars, when compared with the WHO recommended glucose based ORS, is only demonstrable in cholera patients as long as they are not given any food.

Does solid food potentiate the efficacy of ORS?
Principal Investigator: N. Haque Alam
Funded by: UNICEF
The aim of this study, which was completed in 1988 and analysed in 1989, was to examine how food given during diarrhoea improves the efficacy of oral rehydration solutions based on rice or glucose. The experimental design involved studying cholera patients with moderate or severe dehydration treated in one of four different ways: given glucose ORS and no food for 24 hours; given glucose ORS and food throughout treatment; given rice based ORS and no food for 24 hours; finally, given rice ORS and food from the beginning.

ere were no significant differences in ORS intake between groups and no differences between patients who were given food

and those who were not, irrespective of the type of ORS given. However, patients who were given rice ORS, both with and without food, had a smaller stool output, indicating that purging was reduced. ■

There are many proprietary treatments for diarrhoea available without prescription. One preparation commonly used in France is "Sacolene", a mixture of a form of casein, the major protein in milk, and sucrose. This preparation is claimed to have an antisecretory effect, an assertion which is being tested rigorously in a double-blind trial, a form of experimental design in which neither the patient nor the physician know which treatment is being given.

Treating cholera with "Sacolene"
Principal Investigator: F.C. Patra
Funded by: Core funds
After initial rehydration using intravenous fluids, 100 patients with cholera will be randomly assigned to receive 16 g of "Sacolene" a day for two days or the same weight of a placebo. The patients will be given tetracycline after the treatment has been completed. The response to treatment will be evaluated by comparing the rates of purging and the duration of diarrhoea. By the end of the year 81 patients had been studied. ■

People suffering from diabetes mellitus have to be careful how much sugar they consume. Diabetics with acute watery diarrhoea may have exceptional problems because several forms of ORS contain simple sugars.

Treating diabetics with diarrhoea
Principal Investigators: R. Haider and N. Dewan
Funded by: United States AID
The aim of the study is to investigate the effects on the concentration of sugar in the blood of three different types of ORS in diabetics patients aged 15 years or older who are mildly or moderately dehydrated because of acute diarrhoea. The oral rehydration solutions to be studied are rice ORS, glycine based ORS and the standard WHO formula of ORS, but all will contain citrate instead of bicarbonate. By the end of the year 21 of the proposed 75 patients had been studied. ■

The pancreas is an organ with two main functions, one of which is to secrete enzymes into the intestine to digest food. A transient malabsorption of nutrients has been reported to occur during acute intestinal infections, although the mechanism of it has not been explained. The pancreas may be involved.

Pancreatic exocrine function in acute diarrhoea
Principal Investigators: P.K. Bardhan and N.H. Alam
Funded by: Swiss Development Cooperation and United States AID
The aim of this study, which finished during 1989, was to assess the exocrine function of the pancreas of people during acute infectious diarrhoea in comparison with healthy volunteers. The secretion of pancreatic enzymes and bicarbonate was measured after direct stimulation of the pancreas with secretin-caerulin and after indirect stimulation by a standard test drink. The production of two hormones, secretin and cholecystokinin, was also measured. The biochemical analysis of samples is underway. ■

Studies many years ago at the predecessor to the ICDDR, the Cholera Research Laboratory, showed that hypoglycaemia, a low concentration of sugar in the blood, is an important complication of diarrhoea. The incidence and causes of this state have been little studied.

Hypoglycaemia during diarrhoea
Principal Investigators: Michael Bennish and A.K. Azad
Funded by: DANIDA, United States AID and the New England Medical Center
All patients admitted to the Clinical Reserch Centre over a period of eight months had their blood sugar concentration measured and the concentration of hormones involved in controlling blood glucose were examined in a number of patients with hypoglycaemia.

Hypoglycaemia occurred in 98 patients, 4.1% of all those admitted. However, 35% of hypoglycaemic patients died, and their deaths accounted for 21% of all deaths during the study period. Hypoglycaemia was found not to be due either to an excessive concentration of insulin, the hormone responsible for removing glucose from the blood, or to a deficiency of the hormones that help to keep glucose in the blood stream by inhibiting the movement of glucose into cells. Rather, the hypoglycaemia appeared to be due to a deficiency

in the patients' ability to synthesize glucose. Although some hypoglycaemic patients were severely malnourished, most were not, and should have been able to synthesise glucose from body fat and tissue proteins. But because most of the patients in this study who were hypoglycaemic had not eaten for a a long time they were dependent on the body's ability to synthesize glucose, an ability which apparently failed. This study emphasises the need for children with diarrhoea to continue to be fed during their illness. ■

Escherichia coli is a species of bacteria which inhabits the normal human gut. Nevertheless research over the last few years has shown that there are some strains of *E.coli* which can cause diarrhoeal diseases with a wide range of symptoms. These disease causing strains are classified at the moment into five groups: enterotoxigenic *E.coli* (ETEC), enteropathogenic *E. coli* (EPEC), enteroinvasive *E.coli* (EIEC), enterohaemorrhagic *E.coli* (EHEC) and enteroaggregative *E. coli* (EAggEC). Strains of enterotoxigenic *E.coli* are a common cause of acute watery diarrhoea and, as the name indicates, the diarrhoea is caused by toxins. In fact two distinct toxins have been identified, one that is heat labile (LT) and another that is heat stable (ST). Strains of ETEC may produce one or the other toxins, or both together.

Enterotoxigenic *E.coli* (ETEC), usually called "E-tec", are a common cause of diarrhoea in Bangladesh. They are diagnosed routinely at the ICDDR by spreading faeces on an Petri dish of MacConkey's agar, a medium which provides conditions and nutrients for the growth of any *E.coli* present. After incubation a number of colonies typical of *E.coli* are removed and grown again in a broth which is then tested by an enzyme-linked immunosorbent asssay (ELISA) for the presence of toxins. The next two studies reported here have examined different aspects of the current methods for detecting *E.coli*. The first study examined the validity of picking colonies from MacConkey agar on the basis of their appearance: are they always *E.coli*?

The reliability of selecting colonies of *E.coli* from MacConkey's agar by their appearance
Principal Investigator : M.J. Albert
Funded by: Core funds
The aim of this study was to compare with a definitive biochemical diagnosis the practice of selecting from MacConkey's agar colonies of bacteria which appear to be *E.coli*. Stools from 340 patients with diarrhoea were cultured on MacConkey's agar and if there was growth, three colonies resembling *E. coli* were taken to be identified by conventional biochemical tests. Out of 1,020 colonies which appeared to be *E. coli*, 96% were confirmed, suggesting that current practice is satisfactory for epidemiological investigations. ■

The current method of detecting *E.coli* toxins by culturing stools and sub-culturing selected colonies of bacteria in broth is laborious and expensive. In addition, because the plasmid which contains the genes responsible for producing toxins is unstable, the ability to produce toxins may be lost during the process of growing enough organisms for tests. Is sub-culturing really necessary?

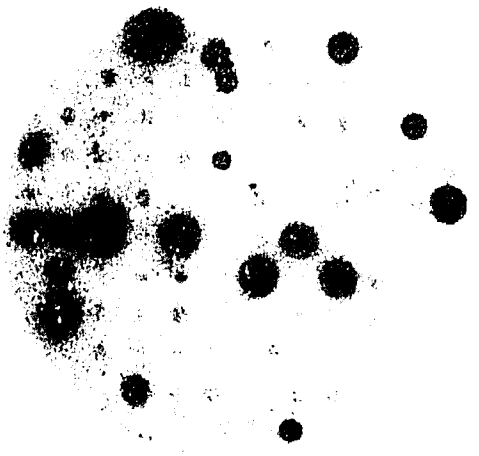
Can *E.coli* toxins be detected in primary culture on MacConkey agar?
Principal Investigators: K. Haider and M.J. Albert
Funded by: Core funds
Although during diarrhoea a pathogenic organism is likely to predominate in the stools, the results of this study suggest that direct testing for ST is unsuitable, although LT can be detected when *E.coli* is present as a pure culture: LT is not detected when there is mixed growth with other coliform bacteria. ■

The contribution of the groups of *E.coli*, other than enterotoxigenic strains, to diarrhoeal diseases in Bangladesh has been little studied.

Detecting *Escherichia coli* which cause diarrhoea in infants
Principal Investigators: K. Haider and M.J. Albert
Funded by: Core funds
This study involved testing cultures of *E.coli* which had been isolated and preserved from 400 children up to one year of age between March and August 1988 during routine surveillance at the Dhaka Treatment Centre (see page 21). Three colonies from each culture were tested for properties known to be associated with pathogenicity. Enterotoxigenic strains of *E.coli* were detected by ELISAs for the toxins produced, while the other groups of *E.coli* were classified by their characteristic effects on HeLa cells grown in tissue culture.

Preliminary results for 500 strains of *E.coli* found 72 which produced heat stable toxin and 51 which produced heat labile toxin, while 147 showed localised adherence to HeLa cells, 79 showed diffuse adherence and 17 showed aggregative adherence. No EHEC were identified. These data will be correlated with the results of tests using gene probes and will be examined in the light of clinical observations. ■

The ability of bacteria to cause disease in man is often associated with specific characteristics, such as the production of substances which are toxic. It is important to bear in mind though that the term "toxin" is given because of its effect on humans: to bacteria the "toxin" may have a metabolic function, it may be a waste product, or it may



Faruque Ahmed/Asem Ansari

A photograph of a developed x-ray film showing the dark spots caused when a gene probe binds to a complementary strand of DNA stuck to a membrane

indeed function to induce changes in its human host which favour its survival. Nevertheless, the process by which many bacteria produce what appear to be specific toxins is very complex and involves the ability to read and decode a specific section of a gene and then to turn on synthetic processes to make that toxin from simple ingredients present in the cell. The stretch of gene which contains the code for a toxin is very likely to be unique and can itself be taken as reliable evidence of the ability actually to produce a toxin. All genetic code takes the form of two long chains of DNA bound together by long strings of substances called bases so that a base on one chain is bound to a complementary partner on the other chain. This fact means that if you can determine the order in which bases occur on one chain in the gene which makes a toxin, then you automatically know the order of bases in the complementary strand. Because it is possible to separate the strands of DNA in a gene by means of gentle heat, if the separated strands are then stuck to a membrane and a synthetic strand of DNA with the correct order of complementary bases is added, it will become stuck to the membrane. By making a radioactive "gene probe", the presence of specific genes can be detected when the membrane is dropped onto photographic film, left for some time, then developed. A photograph of a film exposed to a matrix of membranes is shown to the left: the dark spots are formed where a radioactive gene probe, in this case for EPEC adhesiveness factor, has formed a hybrid with a complementary single strand of DNA in *E.coli* isolated from stools. This technique can be used not only to detect genes for specific characteristics of organisms, but can be used to diagnose species and detect strains of all sorts of causes of disease.

Identifying strains of *E.coli* using specific DNA probes
Principle Investigator: S.M. Faruque.
Funded by: Core funds
The aim of this study is to use specific DNA probes to assess the prevalence of different pathogenic groups of *E. coli*. More than two thousands isolates of *E. coli* have so far been screened for the presence of genes for heat-labile and heat-stable toxins, fimbrial antigens and adhesive or enteroinvasive factors. In a study carried out in collaboration with the Centers for Disease Control in the USA, enteropathogenic and enterohaemorrhagic *E. coli* have been detected in the stools of children with diarrhoea, the first time these groups of *E.coli* have been detected in Bangladesh. A total of 1,148 isolates of *E.coli* from children studied during the Centre's surveillance system (see page 21) were tested with probes for various genes:

10.7% of *E.coli* isolates had genes for the EPEC adhesiveness factor, 6.2% for ST and 12.3% for LT. These isolates are now being tested using conventional methods for the actual factors and toxins to compare the two methods. ■

Another method to identify strains of bacteria relies on the fact that bacteria themselves have pathogens called "bacteriophages", viruses which are often highly specific to certain strains of bacteria. The pattern of susceptibility or insusceptibility of strains of *E.coli* to a number of different bacteriophages can be used to characterise them very specifically and provides a tool to study their transmission and epidemiology.

Studies with *Escherichia coli* bacteriophages
Principal investigator: K.A. Monsur
Funded by: United States AID
Studies at the Centre using bacteriophages have indicated that the variety of strains of *E.coli* present in the initial innoculum of stools on MacConkey agar decreases during the culture process and that the surviving population comprises only a few strains. This is probably a selective process in which certain strains grow better on the medium, but it may mean that a toxigenic strain is missed if it cannot grow as fast as other strains.

Research on bacteria collected during the recent Oral Cholera Vaccine Trial in Matlab has shown that when several colonies of toxigenic bacteria are recovered from a stool sample inoculated onto MacConkey agar, bacteriophages show differences between the colonies isolated. Further testing has revealed that in fact several different strains of enterotoxigenic *E.coli* may be present belonging to different serotypes and containing plasmids of different sizes. This indicates that several different strains of ETEC may occur in one person. ■

During epidemics of cholera in Bangladesh, *Vibrio cholerae* 01 the causative pathogen, can be isolated both from patients and from the environment. However, between epidemics it seems to disappear from the environment, so the question arises: what are the reservoirs or sites of survival and multiplication of vibrios between cholera outbreaks?

The role of aquatic flora in the survival of *Vibrio cholerae* in the environment: a mechanism for the maintenance of endemic cholera?
Principal Investigator: Md Sirajul Islam
Funded by: United States AID
The main aim of this study is to identify plants and plankton which might support the survival or growth of *V. cholerae*, and to examine the relationship between the survival of *V. cholerae* and some environmental conditions such as temperature, pH and dissolved gasses. The study is being carried out in four ponds in Dhaka which are in close proximity to humans and to human effluent. A fifth pond in the Botanical Garden is acting as a control. Pathogenic species of *Vibrio* have been detected in abundance by conventional culture techniques. The species of *Vibrio* detected included *V. cholerae* 01 and non 01, *V. mimicus*, *V. fluvialis* and *V. parahaemolyticus*. ■

Even in a well equipped laboratory a specific pathogen may be isolated from only 70% of faecal samples from people with diarrhoea, so the search for new causes of diarrhoea continues.

Hafnia alvei : a possible cause of diarrhoea?
Principal Investigator : M.J. Albert
Funded by: Core funds
Hafnia alvei is a normal member of the gut flora yet it is rarely cultured from the faeces and has not yet been reported as a cause of diarrhoea. The organism was recently grown in pure culture from the stools of a patient with diarrhoea. No toxins were detected and in tests using animals no invasion of tissues was seen. The isolate produced diarrhoea in fasting adult rabbits. Studies of the lesions produced in rabbits by this isolate are underway. ■

Several type of viruses are recognised to cause diarrhoea. Although group A rotavirus has been diagnosed routinely at the ICDDR for several years using an ELISA, there has been little research in virology at the Centre. The establishment of a Virology Laboratory at the end of 1988 filled this gap in the Centre's research capability. The main thrust of the first year's work concerned research to study the occurence of different serotypes of group

A rotavirus, a group of rotaviruses which are a common cause of acute watery diarrhoea in children less than five years old. The immunoassays used to diagnose rotaviruses mainly involve antibodies to detect outer shell proteins. If these proteins are destroyed, perhaps during storage of the sample before testing, infections may be missed. In contrast, the genetic material of rotaviruses is very stable and probes which bind to rotavirus RNA have been developed by collaborators including Dr. Peter Echeverria at the Armed Forces Research Institute of Medical Sciences in Bangkok. Another diagnostic method established in the Virology Laboratory is called electropherotyping, a technique in which rotavirus RNA is separated in a thin gel by electrophoresis and stained to produce a pattern characteristic of the serotype. The next two reports concern the first research on the serotypes of rotavirus occurring in Bangladesh.

Gene probes to serotype group A rotaviruses of humans
Principal Investigator: Fu Bingnan
Funded by: Core funds
During the year 719 stool samples from a variety of sources which had been found to contain rotavirus by immunoassays were tested using gene probes. The probes detected rotavirus in 376 samples of which 114 were found to be serotype 1, 119 were serotype 2, 40 were serotype 3, 92 were serotype 4. Eleven specimens contained two serotypes of rotavirus and no samples contained serotypes 5, 6 or 8. The probes were found to be specific to rotaviruses. ■

Strains of rotavirus in infantile diarrhoea in Bangladesh
Principal Investigator: Leanne Unicomb
Funded by: Core funds
Faecal specimens or rectal swabs from children in Matlab and from children attending the treatment centre of the ICDDR in Dhaka will be tested along with any other samples submitted specifically for rotavirus testing. After detecting rotavirus using an ELISA the strain of rotavirus will be characterised by RNA electrophoresis; by using serotype specific RNA gene probes; and by immunoassays using monoclonal antibodies. The distribution of serotypes detected will be related to the severity of disease, age group, other pathogens isolated and, when possible, to nutritional status. ■

There is evidence that very soon after birth children may become infected with strains of rotavirus which do not cause diarrhoea. Studies have indicated that such infections with "nursery strains" of rotavirus may afford partial protection against subsequent infection with pathogenic strains and may decrease the severity of later disease. These "nursery strains" could be candidates for an oral vaccine.

Studies of neonatal rotavirus infections
Principal Investigator: Nigar S. Shahid
Funded by: Core Funds
Preliminary investigations have shown that neonatal strains can be isolated from obstetric and neonatal wards in Dhaka. These "nursery strains"" will be characterised using gene probes and enzyme immunoassays and will be compared with strains from other countries. ■

Adenoviruses are found throughout the world and are associated with respiratory tract infections and conjunctivitis in children. In the last few years they have been implicated also as causes of diarrhoea in children in developed countries. The aim of the work reported next is to study their occurrence and importance in Bangladesh.

Investigation of enteric adenovirus (EAdv) as a possible agent of diarrhoea
Principal Investigators: Kerstin Jarecki-Khan and Leanne Unicomb
Funded by: Deutscher Akademisher Austauschdienst and Core funds
Two techniques have been developed to detect enteric adenoviruses: a method to cultivate them directly from stools and an ELISA to detect viral particles in stools and rectal swabs. Preliminary tests on stools from children less than 5 years old have detected enteric adenoviruses in 5% of samples. ■

DYSENTERY

Dysentery is an acute diarrhoeal disease characterised by inflammation of the intestines, abdominal pain and the passage of stools containing blood. Several pathogens are known to be responsible for dysentery, including several species and strains of *Shigella* which causes a disease called shigellosis, invasive strains of *Escherichia coli* and *Campylobacter jejuni*, and a protozoan parasite called *Entamoeba histolytica*, the cause of amoebic dysentery.

For several reasons shigellosis is the most important cause of dysentery in Bangladesh: some strains cause a very severe and debilitating illness; the complications of shigellosis can be life-threatening; the nutritional deterioration of children after shigellosis is often marked; and the several species of *Shigella* seem to be able to become resistant to antibiotics with remarkable speed. Many aspects of the pathogen, the disease and its treatment are being investigated at the ICDDR in studies being undertaken in the community, in hospitals and in laboratories.

A study involving Centre physicians carried out in northern Bangladesh and reported in *The Lancet* (September 3rd 1988, p 552), showed that species of *Shigella* could be isolated from 50% of all children with dysentery. One study resulting from this work is reported first.

Reducing the number of deaths from dysentery in children in the Matlab MCH/FP area
Principal Investigators: Carine Ronsmans and Vincent Fauveau
Funded by NORAD, WUSC/CIDA and BADC.
The initial aim of this study was to see if promptly treating children less than 5 years old with dysentery in their homes has an impact on morbidity and death rates due to shigellosis. Community Health Workers (CHWs) were trained to diagnose cases of dysentery, then the CHWs operating in half of the MCH/FP Treatment Area in Matlab (see page 27) were given nalidixic acid to provide as treatment; CHWs in the other half of the Area referred patients to ICDDR treatment centres. At the same time, a random sample of villages was surveyed to detect cases of shigellosis and collect rectal swabs to diagnose the species of *Shigella* by microbiological culture and to test isolates for their sensitivity to antibiotics.

An evaluation of the project after six months revealed that less *Shigella* had been isolated than expected and that there was no difference in the outcome of shigellosis between those children treated at home with nalidixic acid and those referred for treatment. In the light of these facts surveillance was continued to monitor any seasonal changes in the prevalence of *Shigella*, but CHWs were instructed to refer all children with dysentery for treatment. ■

Shigellosis is responsible for a lot of illness and deaths among children in Bangladesh. If the disease is to be controlled then it will be important to understand what puts children at risk of contracting the disease or of being severely affected by it.

A prospective study of risk factors for the occurrence of shigellosis in Bangladeshi children and its clinical sequelae
Principal Investigator: Faruque Ahmed
Funded by: United States AID and the WHO
Children up to four years old in Matlab who are close contacts of people who develop shigellosis are being visited on alternate days for a period of 10 days in order to identify factors which might put them at risk of also contracting shigellosis. At the end of 10 days the children will be visited weekly for another 21 days and then visited once more 12 weeks after the first visit in order to assess the impact of any infection which develops. The factors to be studied are serum vitamin A, breast-feeding and weaning practices, nutritional status, recent measles, the personal

hygiene of the child and the mother, the family's water supply and storage system, and the food handling practices of the family. Potential prognostic factors for the clinical sequelae of *Shigella* infections will also be studied. By the time the study will end in early 1990 about 2000 children will have been enrolled, of whom about 10% are likely to have developed shigellosis. ■

An abnormal loss of protein through the gut wall has been observed in various gastrointestinal disorders including diarrhoea, and this loss may exacerbate or cause malnutrition. There are two main techniques used at the ICDDR to estimate such losses. The first is by measuring the concentration in the stools of alpha-1-antitrypsin, a blood protein which leaks with other body fluids into the damaged gut, but which withstands digestion. The second is by measuring the concentration in urine of two sugars, one of which, called mannitol, is poorly absorbed by a healthy gut, while the other, called lactulose, is usually well absorbed. When given as a drink the sugars are excreted unchanged in the urine within a few hours of consumption. An abnormally high concentration of mannitol in the urine and an abnormally low concentration of lactulose, when expressed as a ratio, indicates that the gut may be damaged.

Protein losses into the gut in childhood diarrhoea
Principal Investigator: A.N. Alam
Funded by: United States AID
The aim of this study is to investigate losses of protein into the gut of children with shigellosis. The tests being done included measuring the concentration of alpha-1-antitrypsin in stools, measuring lactulose and mannitol in urine after an oral dose, and measuring nitrogen lost into faeces and urine. The effects of drug treatment and zinc supplements on these tests of permeability have also been evaluated. Twenty-eight patients have been studied so far and an interim analysis is underway. ■

The next two studies concern complications of shigellosis, the most common of which is hyponatraemia, a low concentration of sodium in the blood.

Hyponatraemia during shigellosis
Principal Investigators: Michael Bennish and A.K. Azad
Funded by: DANIDA, United States AID and the New England Medical Center
In this study 18 patients with shigellosis and severe hyponatraemia (serum sodium < 125 mmol/litre) were compared with patients with shigellosis but without hyponatraemia, and with patients with moderate or severe dehydration caused by other pathogens. The patients with hyponatraemia were not severely dehydrated but when compared with their controls however, they had higher circulating concentrations of anti-diuretic hormone, a concentration which did not diminish when patients received intravascular fluid. Although patients with shigellosis and hyponatraemia had little thirst when hyponatraemic, when serum sodium concentrations were corrected by the infusion of solutions containing sodium, their thirst increased markedly.

These results suggest that patients with shigellosis and hyponatraemia have both an inappropriate secretion of anti-diuretic hormone and an inappropriate thirst. Although it may seem paradoxical in patients with diarrhoea, these patients may actually have an excess of intravascular water, rather than diminished total body sodium. Treating such patients therefore requires a close attention to both the amount of salt as well as the volume of water that is administered. ■

Although potentially lethal complications of shigellosis occur away from the site of infection in the colon, a severe complication can occur in the form of intestinal obstruction. Intestinal obstruction occurs in 3% of all patients admitted with shigellosis to the Dhaka Clinical Research Centre. The death rate in these patients is 33% and they account for 10% of all deaths in patients with shigellosis.

Intestinal obstruction during shigellosis
Principal Investigators: Michael Bennish and A.K. Azad
Funded by: DANIDA, United States AID and the New England Medical Center
In this study 30 patients with shigellosis and intestinal obstruction were compared with an equal number of patients with shigellosis but without intestinal obstruction. They were

found more often to have alterations in their neurological status, they tended to be younger, and had a much higher number of white cells in their blood. When compared with their controls the patients with intestinal obstruction were surprisingly better nourished and had higher blood concentrations of potassium The use of drugs which inhibit intestinal movement, such as antispasmodics, was not associated with the development of intestinal obstruction Because of the high death rate associated with this complication, treatments other than antimicrobial drugs need to be identified. ■

Many children who contract shigellosis either become malnourished or may have their current malnutrition exacerbated by the disease. Malnutrition may then predispose them to subsequent diseases and so result in an increased risk of dying. The aim of the next two studies is to examine how different diets given to children with shigellosis during the acute stage of their illness might prevent a decline in nutritional status both during and after the disease.

The treatment of growth faltering after shigellosis with a high-protein diet
Principal Investigator: Iqbal Kabir
Funded by: United States AID
The aim of this study is to evaluate the role of a high protein diet in preventing growth faltering during convalesence from shigellosis. In a prospective study 80 children are being given either a high-protein diet or a standard hospital diet for 21 days. Anthropometric measurements are being made before and after treatment and then every 15 days after discharge for 6 months. The concentration in the serum of all proteins, albumin, prealbumin and retinol binding protein are being measured on the first day the high-protein diet is given, at discharge, and after 6 months. The effect of the diets on body composition, total body water and total body fat will be estimated by measuring bioelectrical impedance. Fifty-six children had been studied by the end of the year. ■

A high energy diet for treating undernourished children with acute shigellosis
Principal Investigator : Ramendra N. Mazumder
Funded by : United States AID
In this study 40 patients of both sexes aged 1 to 4 years of age who have had acute shigellosis for less than 72 hours will be randomly assigned to two groups to be studied for 10 days. At admission and prior to any treatment all patients will have two stools cultured, single cultures of urine and blood, a blood count, and the concentration of various substances in the blood will be measured including all protein, serum albumin and retinol binding protein. These tests will be repeated on the fifth and tenth day after admission. One group of children will be given a diet which has twice the density of energy as the other, but with the same ratio of energy to protein. This experimental diet will be given so that each child consumes at least 150 kcal of energy per kilogram of body weight per day. The other diet will provide each child with a minimum of 75 kcal/kg body weight/day. After discharge the patients will be visited twice during the following month to measure growth and assess nutritional improvement. Fifty patients had been studied by the end of the year. ■

Cytokines are a diverse group of proteins produced by certain white blood cells, particularly during infections or in response to tumours. Among their wide-ranging effects cytokines are involved with regulating the immune system, with stimulating fever and with mobilising nutrients to fight infection. The observation that cytokines can cause effects which are similar to those observed during shigellosis suggests that cytokines may be involved in some way in the more severe complications of this disease.

The role of cytokines in the pathogenesis of shigellosis
Principal Investigators: Michael Bennish and M. A. Salam
Funded by: Tufts University
The objective of this three year research study is to investigate the relationship between the production and action of cytokines and life-threatening events in shigellosis. Specifically the aim is to measure in patients with shigellosis the production of the cytokines interleukin-1 alpha, interleukin-1 beta, cachectin (tumour necrosis factor), and granulocyte and granulocyte-macrophage colony stimulating factors, as well as certain acute phase proteins, endotoxins and Shiga toxin. The study will attempt to determine whether a correlation exists between the production of cytokines and the severity of

colitis, fever, leukocytosis, weight loss or the development of specific complications such as leukemoid reaction, hyponatraemia and hypoglycaemia. If correlations are found, patients at risk of complications may be more easily identified and provided with better treatment, particularly to modulate the cytokine response.

Initially 15 patients were studied in order to develop the tests to detect cytokines, acute phase proteins and toxins. By the end of 1989 90 patients had been enrolled in the study, including 46 patients infected with *S. dysenteriae* type 1 and 16 infected with *S. flexneri*. The leukemoid reaction was present in 11 patients, 3 of whom developed a typical haemolytic uraemic syndrome. It is estimated that another 150 subjects will be required to complete the study. ■

Species of *Shigella* are able to acquire bits of genetic material called "plasmids" from other species and genera of bacteria. If other bacteria have evolved a trait which is encoded on plasmid DNA, that trait can be acquired by the transfer of the plasmid to *Shigella*. The consequence of this is that *Shigella* spp. can acquire resistance to antibiotics very easily from other organisms which have independently developed resistance, and this resistance can then spread rapidly within and between species of *Shigella* themselves. Because of the rapid development of resistance to antibiotics, in the space of a few years drugs to treat shigellosis can become useless. For example, resistance by *S.dysenteriae* type 1 to nalidixic acid is increasing in Matlab (see Figure 3 on page 39). For this reason research on new drugs to treat shigellosis is an important part of clinical research at the ICDDR.

Pivmecillinam and gentamicin compared with nalidixic acid for treating acute shigellosis in children
Principal Investigators: M.R. Islam and A.N. Alam
Funded by: United States AID
The aim of this study is to conduct a double blind trial to compare pivmecillinam given at a dose of 50 mg/kg body weight/day and gentamicin at a dose of 30 mg/kg body weight/day, both given orally in four divided doses, with nalidixic acid given at a dose of 60 mg/kg body weight per day. Twenty-five children will be studied in each group for six days during which they will receive regular

Asem Ansari

Many fields of research at the ICDDR involve growing organisms and cells in nutrient media. Because many bacteria and yeast also grow well in such media it is important to use sterile techniques when handling the cells in order to prevent contamination. A clean environment can be provided by a laminar flow hood in which a current of filtered air is blown over sterilised surfaces. Scientists then use careful handling techniques and sterile glassware to manipulate and grow organisms or cells. The hood shown here is in the newly established Cellular Immunology Laboratory which will be undertaking research on the functioning of the immune system during shigellosis and persistent diarrhoea.

physical examinations, the frequency of stools and their characteristics will be recorded, and stools will be cultured daily for *Shigella* spp. Patients will be considered clinically cured when they no longer have fever and if they pass stools without blood or mucus; they will be considered bacteriologically cured when *Shigella* spp. can no longer be cultured from stools. Patients will be asked to return to hospital for clinical and microbiological tests a week after release from hospital. By the end of the year 64 patients had been studied and 34 had returned a week later for tests. ■

A previous study at the ICDDR showed that a five day course of ciprofloxacin was a better treatment for shigellosis than ampicillin. If a single dose of ciprofloxacin was as effective as five days treatment then there would be advantages in terms of cost and to ensure compliance in taking the drug.

Single dose ciprofloxacin for shigellosis
Principal Investigators: M.A. Salam and Michael Bennish
Funded by: Core funds
The objective of the study is to compare the effectiveness of the conventional regimen of treatment using ciprofloxacin given as two daily doses of 500 mg for five days, against either a single dose of 1 g or two doses of 1 g given 24 hours apart. The bacteriological and clinical cure rates will be compared between groups. By the end of the year 37 out of the 150 patients required to do the study had been enrolled. ■

Shigella spp. and enteroinvasive *Escherichia coli* (EIEC) produce dysentery by invading and multiplying within the cells lining the colon. Their ability to multiply is associated with the production of a contact haemolysin (CH), so called because red blood corpuscles are lysed when they come into contact with the bacteria. Since *Shigella* and *Escherichia* are closely related genera, the aim of the study reported next was to examine whether strains of EIEC also share with species of *Shigella* the ability to produce CH, and to compare various aspects of CH production in both groups of organisms.

Contact haemolysin production by *Shigella* spp. and enteroinvasive *Escherichia coli*
Principal Investigators: K. Haider and M.J. Albert
Funded by: Core funds
The medium in which EIEC produced the most CH was found to be one containing casamino acid and yeast extract supplemented with 1mM $CaCl_2$, while for *Shigella* spp. it was trypticase soy broth with 0.6% yeast extract. For both groups of bacteria guinea-pig red blood corpuscles provided the best means of demonstrating CH activity. The production of CH by strains of both EIEC and *Shigella* was dependent on temperature: the most lysis occurred when organisms were cultured at 37oC. There was a good correlation between the amount of CH produced and the multiplication of bacteria when grown in culture with HeLa cells. In all strains of EIEC and in all species of *Shigella* studied CH activity was found to be dependent upon the presence of a particular large plasmid. ■

The characteristics of enteroinvasive *Escherichia coli* isolated from various geographical locations
Principal Investigators: K. Haider and M.J. Albert
Funded by: Core funds
The aim of this study was to compare the characteristics associated with virulence of 40 strains of EIEC isolated in Thailand (35), Australia (3) and Bangladesh (2). All strains bound Congo red dye, agglutinated guinea pig red blood corpuscles, produced a contact haemolysin and were hydrophobic in salt aggregations tests. All strains adhered to HeLa cells but only one strain produced a cytotoxin. The isolates exhibited different plasmid profiles and were sensitive to different bacteriophages. All 21 strains of a particular serotype from Thailand contained indistinguishable plasmids and were sensitive to the same bacteriophages (see page 8), but the plasmids and bacteriophage sensitivity of strains of the same serotype from Australia and Bangladesh were different. ■

Except for vaccination against polio, the traditional means of immunisation against a disease has been by injection. Yet the observation that the disease caused by a pathogen of the intestinal lumen can stimulate a strong and protective immune response has brought with it the realisation that protective immunity might be stimulated by an orally administered vaccine. One possible means of achieving this would be to develop a strain of

a pathogen which did not cause disease but which stimulated an immune response against virulent strains.

A strain of *Shigella flexneri* Y as a potential live oral vaccine.
Principal Investigator: Zia Uddin Ahmed
Funded by: United States AID
A thymine requiring strain of *S. flexneri* Y which grows best at 30°C rather than 37°C, has been used to orally vaccinate monkeys in a collaborative study with the National Institute of Immunology, New Delhi. The study involved tests of safety, immunogenicity and protective potential on a limited number of monkeys. An oral dose of 10^{11} cells invaded epithelial cells but did not cause disease. Protection against a challenge of bacteria was achieved by immunisation with two doses of 10^{11} cells given seven days apart. Immunisation with a dose of fewer organisms did not afford protection. The bacteria used to challenge immunised animals were seen inside phagocytic cells of the intestines suggesting the possibility of a cell-mediated immune response.

The chances of the mutant strains used in these tests reverting to become pathogenic have been calculated to be less than 1 in 10^{14}. The strain shows no toxicity or pathogenicity in the usual tests of virulence and is sensitive to the most commonly used antibiotics. Because the strain has an antigen characteristic of the most common serotype of *S.flexneri* occurring in south Asia, it may provide cross-protection. The next step is to define the mutation and determine whether or not it is the result of a deleted gene. ■

The crucial first step in the process by which a gut pathogen causes disease involves the attachment of the organism to the gut wall. For species of *Shigella* this attachment is the first step in penetrating the cells in which they multiply, and is thought to be due to a large molecule called a lipopolysaccharide (LPS) which acts as an "adhesin". Because the action of LPS is difficult to study *in vivo*, a term literally meaning "in life", an experimental system *in vitro*, or "in glass", has been developed involving red blood corpuscles: they clump together or "haemagglutinate" when mixed with LPS or when mixed with bacteria with the LPS on their surface.

Haemagglutinating ability and adhesiveness of *Shigella dysenteriae* type 1
Principal Investigator: Firdausi Qadri
Funded by : United States AID
Earlier research has demonstrated the haemagglutinating activity of strains of *S. dysenteriae* type 1. The LPS extracted from *S.dysenteriae* type 1 has been shown to agglutinate erythrocytes obtained from guinea pigs, sheep, rabbits and monkeys and with human blood of groups O, A and B. Haemagglutination was inhibited by antiserum to LPS and by sialic acids. The LPS obtained from non-pathogenic "rough" mutants of *S. dysenteriae* type 1 or nonhaemagglutinating *Shigella* species such as *S. sonnei* and *S. boydii* did not agglutinate erythrocytes. This was shown to be due to the fact that the O-antigen, a polymer of sugars, was missing from the LPS.

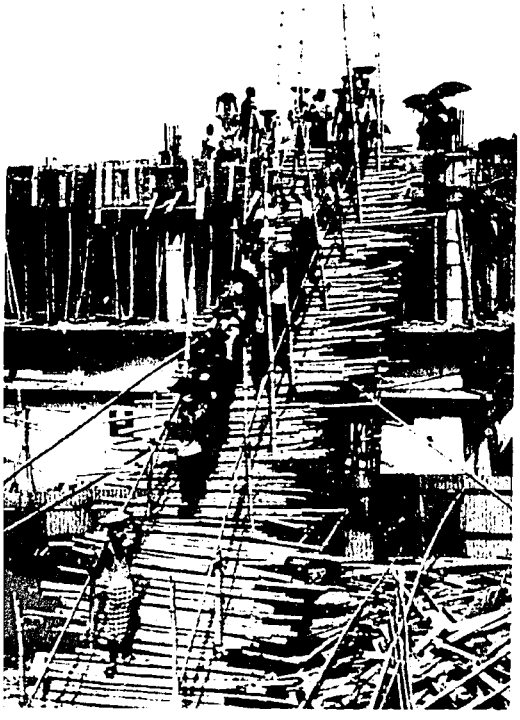
Strains of *S. dysenteriae* type 1 were shown to adhere to intestinal cells grown in culture and to human mucin although there was no difference between haemagglutinating and non-haemagglutinating strains or between virulent or avirulent "smooth" strains. Only "rough" mutants of *S. dysenteriae* type 1 showed little binding. It appears that the haemagglutinating ability of *S. dysenteriae* type 1 is related to the production of slime by the bacteria. Further studies are being carried out on the mechanism of this process. ■

Once established within a host's body cavities or tissues some bacteria secrete enzymes which perhaps function to digest host cells and so provide simple nutrients for growth and multiplication of the organism.

Extracellular hydrolytic enzymes activity in *Shigella* species
Principal Investigator: Khaleda Haider
Funded by: Core funds
Extracellular hydrolytic enzymes have been implicated as factors which determine the virulence of several microbial pathogens. To investigate the possible role of such enzymes in species of *Shigella*, differences in 20 extracellular enzymes were examined in 25 pairs of virulent and avirulent strains of *S. dysenteriae* type 1, *S. flexneri* type 2a, *S. boydii* and *S. sonnei* form 1. In addition, "rough" mutants of *S.dysenteriae* type 1 and *S.sonnei* were also screened.

Md. Salim

Carine Ronsmans



Andrew Hall

Asem Ansari

Preliminary results show that virulent and avirulent mutants of all *Shigella* strains produce mucinase, lipase, esterase, neuraminidase and alkaline phosphatase. There appears to be an interesting difference however between "rough" mutants and virulent strains of *Shigella dysenteriae* type 1. The ability of the enzyme mucinase to digest mucin from different source was different: the enzyme was most active against guinea pig mucin followed by human, bovine and rabbit mucin. This data suggests that species of *Shigella* could digest the mucin lining of the intestinal mucosa in the initial stages of establishing an infection in the gut. ■

In tropical developing countries, *Campylobacter jejuni* is often isolated with equal frequency both from people with and without diarrhoea. This makes it difficult to be sure that when *C.jejuni* is isolated it is in fact the cause of the diarrhoea — a pathogen not detected may be responsible. Studies of the production of toxins have also failed to show differences between organisms isolated during diarrhoea or from healthy people but this may simply reflect that conditions for microbiological culture are not ideal.

The growth of *Campylobacter jejuni* in media supplemented with minerals and its pathogenicity
Principal Investigators: S.Q. Akhtar, Md A.B. Siddiqui and A.A. Khanam
Funded by: Core funds
The first aim of these studies was to grow *C.jejuni* in media supplemented with iron or zinc at different concentrations to examine their effects on growth. The second aim was to see if growth with optimally adjusted concentrations of minerals had any effect on the ability to distinguish between strains isolated from people with diarrhoea and strains from apparently healthy subjects in terms of their production of toxins.

The growth of organisms was enhanced by the addition of iron, while extracts of 30% of the organisms isolated from people with diarrhoea were toxic to highly sensitive cells grown in culture. No toxic effects were seen for extracts of organisms from healthy controls. Trace amounts of zinc in concentrations of 0.25 - 0.5 nM/ml stimulated the growth of *Campylobacter jejuni*. ■

Entamoeba histolytica is a protozoan parasite of the large intestine which can invade tissues and cause dysentery. It's contribution to dysentery in Bangladesh is uncertain but *E.histolytica* has been implicated as a cause of death among patients receiving treatment at the Centre's hospital. There are known to be at least 20 strains of *E.histolytica* of which about eight are associated with an ability to cause dysentery. Strains cannot be distinguished on the basis of their microscopical appearance but can be identified by staining three specific enzymes after electrophoresis of cell extracts: the pattern of the enzymes uniquely identifies the strain or "zymodeme".

Entamoeba histolytica in Bangladesh
Principal Investigators: Rashidul Haque and Andrew Hall
Funded by: British ODA and Core funds
Stools containing *E.histolytica* from patients with dysentery who were attending the Clinical Research Centre of the ICDDR were inoculated into Robinson's medium to culture *E.histolytica*. Stools were also cultured from apparently healthy slum dwellers found to be infected with the parasite. The enzymes extracted from lysed organisms were subjected to cellulose acetate electrophoresis to characterise their zymodeme. Pathogenic zymodemes II and XIV were isolated from 31 out of 34 stools from hospital patients while non-pathogenic zymodemes I and XIV were isolated from 34 of 37 samples from people living in the slums. These techniques will be used in further studies of *E.histolytica* as a cause of dysentery in Bangladesh. ■

PHOTOGRAPHS OPPOSITE. Top left: Women being taught how to make a homemade oral rehydration solution from sugar and salt as a part of the Urban Volunteer Programme (see page 22). Middle right: a fieldworker putting an infant into trousers before weighing it as part of a project on Giardia and persistent diarrhoea (see page 19). Middle left: New offices being built on top of the Centre's Library . Bottom right: Conditions in the hospital were improved during 1989 with the installation of air conditioning and a drop ceiling.

PERSISTENT DIARRHOEA

The term "persistent diarrhoea" is used to describe episodes of diarrhoea which last for longer than expected. A somewhat arbitrary cut-off point used to define "longer than expected" is often taken to be 14 days, a duration of illness which reflects the fact that most diarrhoeal diseases get better on their own and are said to be "self-limiting". Studies in many developing countries have estimated that anything up to 20% of acute episodes of diarrhoea in children become persistent, and that persistent diarrhoea increases a child's chances of dying.

Although certain pathogens have been found to be associated with persistent diarrhoea, such as enteropathogenic *E.coli*, *Clostridium difficile*, *Giardia intestinalis* and species of *Shigella*, *Campylobacter* and *Aeromonas*, there is a growing awareness that changes in the intestinal environment — which includes the natural flora as well as the physical and chemical characteristics of the gut — may lead to persistent diarrhoea. One of the changes observed in the gut of children with persistent diarrhoea is that larger numbers of organisms than usual may be found high up the small intestine, a region of the gut normally not colonised to any great extent.

Studies on the causes of persistent diarrhoea in children.
Principal Investigators: M.J. Albert, K. Haider, S.Q. Akhtar, P.K. Bardhan, D. Mahalanabis and N.A. Bhuiya
Funded by: Core funds
The aim of this study is to determine the species of bacteria present in fluid collected from the upper small intestines of children with severe persistent diarrhoea and to quantify the numbers of aerobic and anaerobic organisms present. The results will be compared with tests on children with mild persistent diarrhoea or with acute diarrhoea. Two jejunal fluid samples will be studied from each patient, one at enrolment and the other after different types of treatments, to examine changes in the bacterial flora. The coliform bacteria isolated will be tested for their ability to produce toxins and to damage cells grown in culture. If an isolate shows no pathogenic properties it will be inoculated into the intestines of rabbits to see if diarrhoea is produced. Stool specimens will also be tested by conventional means for bacterial pathogens, parasites and viruses.

By the end of the year samples of jejunal fluid had been tested from 37 patients of whom six had provided a second sample. No organisms were cultured from six of the 37 initial samples, but when organisms were found to be present the concentration of bacteria was as high as four million/ml of fluid. The bacteria isolated included *E. coli* and species of *Klebsiella*, *Enterobacter*, *Citrobacter*, *Campylobacter*, *Salmonella*, *Pseudomonas* and *Acinetobacter*. ■

In the absence of a clear understanding of the causes of persistent diarrhoea no standard treatment has emerged and treatments tend to be empirical. Some success has been achieved, however, by removing from the diet certain foods to which intolerance sometimes develops, such as those based on cow's milk, and by giving bland diets of easily digested and nutritious foods.

The absorption of nutrients by children with persistent diarrhoea
Principal Investigators: S.K. Roy, R. Haider and S.M. Akramuzzaman
Funded by: United States AID
In this study 26 male children with persistent diarrhoea were given a diet based on locally available grains. Their ability to absorb energy, fat, protein and carbohydrate was then compared with 25 healthy children of similar ages. The diet led to the recovery of 21 patients within 7 days; five patients required further treatment. The percentage absorption of nutrients by study and control children was respectively as follows: energy 64% and 87%; fat 62% and 91%, protein 43% and 68%, and

carbohydrate 74% and 92%. All differences were statistically significant. The subjects who failed to respond to the diet showed a greater degree of malabsorption than those who improved. Children with a large initial stool volume were also less likely to improve over 7 days of treatment. ■

Treating persistent diarrhoea with a diet based on coconut oil and comminuted chicken
Principal Investigators: P.K. Bardhan and N.H. Alam
Funded by: United States AID
In a metabolic balance study a diet containing coconut oil — a rich source of medium chain triglycerides — will be compared with a soya bean oil diet of the same density of energy. Eighty children aged 3 to 12 months with diarrhoea for more than 2 weeks will be randomly assigned to the two dietary groups. Clinical responses and nutrient absorption will be assessed and related to the functional derangements identified by various laboratory investigations, and then compared between the two dietary groups. Subjects will be visited at home for two months after discharge to monitor the outcome of treatment and to ensure adequate feeding. By the end of the year 26 patients had been studied. ■

Zinc is an element known to be involved in the permeability of membranes. Probably the largest membrane in the human body in terms of surface area is the one lining the gut.

A study of the effect of zinc supplements on mucosal permeability in persistent diarrhoea
Principal Investigators: S.K. Roy, R. Haider and S.M. Akramuzzaman
Funded by: The Wellcome Trust
To test the hypothesis that zinc supplements can reduce the magnitude of diarrhoea by improving mucosal permeability and by improving water and electrolyte transport, a double blind randomised control trial was undertaken in children with both acute and persistent diarrhoea. Since March 1987 a total of 192 patients with persistent diarrhoea aged between 4 and 24 months were studied in two groups, one of which was given zinc acetate for 14 days while the other received a placebo. Intestinal permeability was measured using the lactulose and mannitol test (see page 11). Children were then visited at home each week for three months to measure their growth. A reduction in the duration of diarrhoea was observed in children given zinc, and mucosal permeability improved significantly. ■

Earlier work on the organisms isolated from the intestines of children with persistent diarrhoea showed that most species were sensitive to the combination of two drugs, trimethoprim and sulphamethoxazole, sometimes abbreviated to cotrimoxazole.

Cotrimoxazole as treatment for persistent diarrhoea in infants and children
Principal Investigator: N.H. Alam and R. Haider
Funded by: United States AID
The aim of this study is to evaluate the effect of treating children with a broad spectrum antibiotic for persistent diarrhoea. Two groups of 26 children aged 3 to 24 months with diarrhoea for more than 14 days will be studied. All patients will be given a special diet containing egg albumin, oil, rice powder, vitamins and minerals. The effects of cotrimoxazole on the clinical response of children and on the bacteria of the small intestine will be studied (see above). ■

Giardia intestinalis is a protozoan parasite of the small intestine which has been associated with persistent diarrhoea, fat malabsorption and severe weight loss, yet on some occasions it causes no illness at all. Its role as a cause of growth faltering in young children is equivocal, and it was the aim of the study reported below to examine the effects of *Giardia* on the growth of a cohort of infants living in an urban slum.

Giardia and persistent diarrhoea in young children
Principal Investigator: Andrew Hall
Funded by: United States AID and British ODA
This study, which began in December 1987 and finished in November 1989, studied the health and growth of 229 young children who were aged between 2 and 8 months at enrolment. Their health was recorded each week, their growth was measured once a month, and stool samples were collected once a month or whenever children had diarrhoea. A preliminary analysis of results indicates that 60% of children had at least one infection with *Giardia* during the 23 months of the investigation and that 14% of all episodes of diarrhoea lasted for 14 days or more. Tests

on the permeability of the intestines of 42 children were also done. Further tests on stool samples are being performed and the data analysis is underway. ■

There is no good explanation yet for the range of symptoms seen during infections with *Giardia intestinalis*. They range from persistent diarrhoea with fat malabsorption and weight loss to no symptoms at all. One explanation for this variation may lie in differences between strains of the organism. A common technique used to distinguish between strains of protozoa is enzyme electrophoresis: different strains of protozoa may have two versions of the same enzyme with the same biochemical function but with different physical properties. These different forms of the same enzyme can often be distinguished by differences in the extent to which they move through a gel when an electric current is applied, a technique called electrophoresis.

Identifying and characterising strains of *Giardia intestinalis*
Principal Investigators: Andrew Hall and Anwar Hossain
Funded by: United States AID and British ODA
Of the 37 enzymes studied, 26 were shown to be present in *Giardia* and 5 showed isoenzymes. Differences were shown between two isolates of *Giardia* from Bangladesh and five obtained from elsewhere. By growing single organisms it was possible to obtain pure strains of the two isolates from Bangladesh, which showed that one of the isolates contained at least 5 strains of *Giardia*. ■

URBAN HEALTH RESEARCH

Bangladesh had an estimated population of 115 million people at the middle of 1989, and it is increasing at a rate of over 2% a year: by the year 2000 the population density will probably have risen from the current figure of 800 people/km^2 to nearly 1,100 people/km^2. Urban areas in Bangladesh currently contain only about 13% of the country's population, but that proportion is likely to increase sharply as landless people move to the cities looking for work. This migration of the landless poor from rural areas to cities has been the trend in many other developing countries, and typically it results in the growth of crowded urban slums with inadequate water supplies, negligible sanitation and meagre health care. Conditions in the urban slums are often ideal for infectious diseases to be spread widely and rapidly, while malnutrition may put children, who make up over 40% of the urban population, at particular risk. Understanding more about the health problems of poor city dwellers is a growing concern of the ICDDR.

One passive way of doing research on diarrhoea in a city is to study those who come for treatment: it is a self-selected sample, probably of the sickest and poorest people who live closest to the treatment centre, but it can be revealing. The ICDDR provides free treatment for diarrhoeal diseases to about 70,000 people each year who visit its Clinical Research Centre (CRC) and every twenty-fifth patient is asked to take part in a systematic study of the clinical characteristics of diarrhoea and its causes.

Diarrhoea Surveillance System
Principal Investigator: A.N. Alam
Funded by: UNDP/WHO

During 1989 a total of 2,401 patients were asked to take part in the diarrhoea surveillance programme, 4% of the number who came for treatment. Each patient or guardian of a patient was interviewed then the patient was given a thorough physical examination by a physician and anthropometric measurements were made. Unless a patient did not stay or refused to take part, a stool sample or rectal swab was collected to be cultured for *Salmonella* spp, *Shigella* spp and *Vibrio* spp, and for a microscopical examination.

Table 1
The major bacterial pathogens isolated each month during 1989 as a part of ti[illegible]lance of 4% of patients atten[illegible]ical Research Centre of the ICDD[illegible]

Months	Samples tested	Salm-onella spp	Sh ella spp	Vibrio cholerae 01	[illegible]r Vibrio spp
January	190	2	31	10	29
February	154	1	21	2	19
March	204	1	16	3	26
April	339	3	26	19	55
May	325	0	44	47	23
June	226	1	35	13	32
July	167	3	17	3	33
August	152	3	16	1	16
September	138	8	14	0	29
October	157	7	27	3	22
November	149	6	24	1	21
December	183	4	24	2	18
Total	2384	39	295	104	323
Percentage		(1.6)	(12.4)	(4.4)	(13.5)

Information about the major pathogens isolated from 2,384 faecal samples provided by people who agrred to take part during 1989 is shown above. ■

The current population of Dhaka is estimated to be five million and is likely to double in the next ten years. At the moment as many as one million people live in the slums scattered throughout the city and up to 15% of them are children less than five years old. The health of children — and the health of their mothers upon whom they depend — is a major concern for research at the ICDDR under the heading of "Child Survival". Dhaka

is an ideal place to conduct two types of research on children and their mothers in poor urban communities. The first type of research is in the field of epidemiology: the study of disease in the community. The second type of research, on how best to provide health services which meet the greatest need, is given the title "operations research".

Urban Volunteer Programme

Project Director: Diana Silimperi

Funded by: United States AID, Belgium and France

The Urban Volunteer Programme (UVP) is a project which combines operations and epidemiological research with providing essential primary health care to the urban poor. Its main goal is to create and evaluate a health delivery system for poor urban people using volunteers based in their communities, to conduct operations research and to gather data about health services in urban slum communities. The UVP has four main characteristics: to work in urban slums, to prevent ill health, to promote the key role of women, and to achieve its aims using volunteers. The UVP promotes four means to prevent ill health: nutritional education, preventing diarrhoea by means of hygienic practices, family planning and immunisation.

During 1989 information on the services provided by about 1,300 mainly illiterate volunteers was recorded using specially designed symbol calendars. Some of the highlights are:

- about 168,000 families were served, an average of about 28,000 families a month
- over 200,000 people were provided with ORS packets and health education, and nearly 3,000 patients were referred to the ICDDR for treatment
- about 16,600 women and children were referred to vaccination centres
- over 8,500 women were referred for family planning methods while nearly 31,000 people were given family planning advice
- nutritional education was given to nearly 30,000 people
- 1,800 vitamin A capsules were distributed
- over 3,300 children were referred for nutritional evaluation and treatment.

An Urban Slum Surveillance System (USS) was created during 1989 to gather representative information about the characteristics of urban slums in Dhaka. This information will serve as a basis to evaluate the effectiveness of the delivery of urban health services. A total of 166 clusters of households drawn from 66 representative slum communities were randomly selected to provide a sample of about 40,000 people in about 6,000 households. About 60% of the households have children less than five while 47% have children less than three years old.

The aim of this work is to assess the effectiveness of urban volunteers as providers of health care, to study the impact of volunteers on certain indicators of health, and to establish a structure to conduct research within Dhaka's slums. Communities with and without volunteers will be compared in terms of the health of the communities, the knowledge of mothers about health matters and in terms of their hygienic practices.

In 1989 about 340 children were treated in the UVP's three nutritional rehabilitation units. During the year all three units were renovated and a new centre was opened to replace one damaged by the floods of 1988.

The two-year pilot supplemental food programme run in conjunction with one of the nutrition rehabilitation centres concluded during the year and an analysis of its effect is underway. Preliminary results reveal that the mean weight gain of children participating in the programme for at least 6 months was 1 gm/kg of body weight/day.

The UVP continued its collaboration with the Child Health Programme (see page 35) in training 70 volunteers at the hospital during 1989. This training project combines skill development with service to the Clinical Research Centre. An evaluation of the training on the volunteers' subsequent service is planned.

During 1989 the UVP collaborated further with the CHP to visit the home's of children who had dropped out of the CHP's immunisation or nutritional programmes. The UVP also referred children directly to the CHP.

Two other major activities of the UVP during the year were to tabulate nearly four years' data about the health of urban children

from a sample of over 3,000 families, and to complete the first part of a study to evaluate the accuracy of deciding on a cause of death by interviewing close relatives, a "verbal autopsy". ■

Zinc and iron are both trace elements essential for the general health of all tissues. Zinc is involved in the action of several hormones including insulin, it is a co-factor or active component of several major enzymes, and severe deficiencies are associated with dwarfism and impaired healing. Iron is an essential constituent of haemoglobin, the oxygen-carrying pigment of the blood, and of enzymes in every cell of the body. Deficiencies of both elements are particularly common when diets are poor both in quality and quantity, and the absorption of whatever amounts of these trace elements are present can be impaired by substances called phytates present in vegetable foods. Because both elements are involved in normal growth and resistance to infection, a deficiency during childhood may lead to stunting and a predisposition to disease.

The effects of zinc and iron supplements on the growth and morbidity of underprivileged children
Principal Investigators: S.M. Akramuzzaman, A.K. Mitra, S.K. Roy and D. Mahalanabis.
Funded by: Core funds
The aim of this study is to provide children aged between two months and four years living in urban Dhaka with supplements of zinc and iron. The effects of these minerals will be evaluated in terms of reducing illnesses due to diarrhoea and acute respiratory tract infections, and in terms of the childrens' growth rates. The initial phase of the study will involve a census and mapping households in each area, identifying suitable children, training fieldworkers and standardising procedures. Supplementation, monitoring and data collection will begin in 1990. ■

It has been estimated that about 25% of the world's population are infected with *Ascaris lumbricoides*, the intestinal roundworm. *Ascaris* is one of the most common infections in Bangladesh and it is likely that 80% of the population are infected. There is a growing awareness that the distribution of worms within a community of hosts is neither uniform nor random — they tend to be aggregated so that about 30% of people may harbour about 70% of all worms. It is not yet certain whether heavily infected people are in some way predisposed to heavy infections.

Is there evidence for a predisposition to heavy infections with *Ascaris*?
Principal Investigators: Andrew Hall and Kazi Selim Anwar (IPH)
Funded by: United States AID and British ODA
A total of 1,765 people living in an urban slum collected all their worms in buckets after treatment with a drug which paralyses the worms so that they are expelled from the gut. About 60% of the total worms were recovered from about 25% of people; nearly 40% of people passed more than 15 worms and were classified as being heavily infected; and nearly 10% of people passed over 100 g of worms. The average worm burden was 17 worms but and over half of children aged one year old were infected. The average worm burden was found to rise rapidly with age and fall a little in adulthood.

A total of 1,257 people were dewormed on a second occasion six months later and it was found that reinfection was not random. The effects of deworming on the growth of about 250 children aged between 4 and 10 is also being studied. ■

POPULATION STUDIES

Since the early days of the Cholera Research Laboratory population studies have been an important subject for research. This sphere of research arose originally from the need to provide demographic information about large numbers of people for field studies of cholera vaccines. In recent years population studies have grown in importance at the Centre because of the recognition that ill-health is often not a simple matter of cause and effect: diarrhoea or malnutrition, for example, may have immediate biological causes, but their occurrence and prevalence is strongly associated with the broader social and cultural circumstances in which people live. The information which has been collected by population scientists at the ICDDR over the last two decades is unique in the developing world and provides unparalleled opportunities for research on the relationships between populations and ill-health.

Demographic Surveillance System
Project Director: Michael A. Strong
Funded by: Canadian International Development Agency

The Demographic Surveillance System (DSS) addresses the Centre's priority for research on the population in two ways. First, by maintaining long term records on people living in rural communities the DSS provides a structure which allows studies of those communities to be undertaken by the Centre's scientists. The DSS records, for example, made possible the recent Oral Cholera Vaccine Trial (see Annual Reports of 1987 and 1988). Secondly, the scientists of the DSS themselves also conduct valuable research on the links between demographic, socio-economic, epidemiological and biological factors at work within a poor rural community in Bangladesh. This research provides a broader perspective to the Centre's work, based on communities and populations, and provides useful information for comparison with other areas of Bangladesh and with other countries in the developing world.

Matlab

Since 1963 the Centre and its predecessor have conducted health research at a field station in Matlab upazila, a rural area south-east of Dhaka; the DSS has been an important component of this work. Beginning with a census in 1966, increasingly detailed information about demographic events has been recorded, including births, deaths, migration, the outcome of pregnancies, and changes in marital status. In 1977 the area under surveillance was divided into two parts: in one part, usually called the "Treatment area", a Maternal and Child Health and Family Planning Programme (MCH/FP) was started (see page 27); in the other part, usually called the "Comparison area", only the normal government family planning and health services are available, although people there also have access to the Centre's hospital in the town of Matlab Bazar. At the beginning of 1989 the two areas contained about 200,000 people living in 142 villages.

The microcomputer installed in Matlab late in 1988 proved its usefulness during 1989. Data are now entered in the field, which allows most discrepancies to be identified and resolved on the spot, before the data are sent to Dhaka. During the year a great deal of progress was made on the database being created on the mainframe computer (see page CIS report, page 42). This project links the data collected in the 1982 census with information concerning vital events gathered in subsequent years. When it is finished this database will allow individuals, households, or whole communities to be studied over time.

Although the data have always been collected carefully and tested for discrepancies, in the past only limited testing of data between different years was possible because of severe restrictions imposed by the old mini-computer. While loading data into the new database on the new mainframe computer many more inconsistencies than

expected have been found. While they have not been important enough to affect previous estimates of vital rates, some inconsistencies, such as an apparent marriage between two people who were already married due to the incorrect entry of registration numbers, would affect the ability to track people over time, and so had to be resolved. While most data have been found to meet the rigid consistency tests imposed, many inconsistencies require complex detective work. By the end of 1989 the first phase of database creation funded by CIDA, which linked events from 1982 to 1986, had been completed. The database should be nearly up to date by the end of 1990.

Teknaf

After a major outbreak of shigellosis in the south-eastern corner of Bangladesh brought attention to this disease, the Centre established a second field station in 1974 in Teknaf, close to the border with Burma. Modelled on the demographic surveillance system in Matlab, the project in Teknaf has recorded all vital events in four large villages since 1976. The results of work in Teknaf have provided useful comparisons with research in Matlab because very little health care has been provided to the inhabitants of Teknaf who live in a remote community and are conservative in their attitudes. At the

Table 2

Population dynamics in the Matlab Treatment Area, in the Matlab Comparison Area and in Teknaf, from 1978-1988. The Matlab Treatment Area is served by the Centre's MCH-FP Programme while the Comparison Area is served by the government health services alone.

Vital rates (per 1000 people)	Area	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
ALL DEATHS	Treatment Area	12.5	12.1	11.3	11.9	12.5	12.1	13.4	10.1	9.9	9.4	8.7
	Comparison Area	13.8	15.6	14.8	14.4	15.9	18.0	17.3	14.2	12.1	11.1	11.1
	Teknaf	14.7	15.9	12.8	14.2	13.3	14.7	17.1	12.8	13.4	17.0	-
NEONATAL DEATHS[a]	Treatment Area	69.0	70.9	59.3	66.4	58.1	56.4	57.9	51.8	49.6	43.5	43.0
	Comparison Area	78.7	74.6	72.7	69.5	68.1	70.3	71.4	69.5	51.8	55.2	57.2
	Teknaf	78.8	85.6	75.0	88.2	72.8	88.4	96.0	77.5	81.0	83.8	-
POST-NEONATAL DEATHS[a]	Treatment Area	45.5	43.5	32.6	36.1	47.5	41.8	56.9	34.2	37.5	34.9	38.9
	Comparison Area	47.0	43.3	41.3	45.0	50.2	42.2	55.7	49.0	37.7	39.2	39.8
	Teknaf	54.3	57.1	46.8	51.2	46.1	65.4	56.4	45.9	46.2	57.3	-
CHILD (1-4 YRS) DEATHS	Treatment Area	22.5	17.1	18.6	19.1	18.8	21.9	23.1	16.0	13.1	9.8	7.4
	Comparison Area	22.1	26.2	25.4	24.8	27.4	35.3	39.2	24.6	20.1	14.9	14.3
	Teknaf	16.8	16.9	13.7	14.9	10.5	12.3	22.1	11.9	12.5	21.6	-
BIRTHS	Treatment Area	32.1	34.9	37.1	35.3	36.9	33.8	30.7	34.4	33.3	33.5	30.9
	Comparison Area	37.7	47.0	45.5	43.8	44.7	42.4	37.3	42.6	40.0	39.1	40.5
	Teknaf	45.1	55.6	52.4	51.5	53.2	53.4	54.8	54.4	55.5	57.5	-
TOTAL FERTILITY RATE[b]	Treatment Area	4.5	4.8	5.1	4.8	5.0	4.5	4.0	4.5	4.3	4.1	3.7
	Comparison Area	5.5	6.9	6.7	6.3	6.3	6.1	5.1	6.0	5.5	5.2	5.4
	Teknaf	6.7	8.1	8.1	7.7	7.9	7.5	7.8	8.1	8.1	8.6	-
NATURAL INCREASE	Treatment Area	19.6	22.9	25.8	23.4	24.3	22.3	17.3	24.3	23.4	24.1	22.2
	Comparison Area	23.9	31.4	30.6	29.4	28.8	25.8	20.0	28.4	27.9	28.0	28.0
	Teknaf	30.4	39.7	39.6	37.3	39.9	38.7	37.7	41.8	42.1	40.5	-

[a]Per 1000 births [b]Per woman - = Figures not available

beginning of 1989 there were over 80,000 people in the Teknaf DSS area.

Since most health research activities in Teknaf have been completed and because no new studies are anticipated, the Board of Trustees decided in 1989 to close the field station. Because the Teknaf diarrhoea treatment centre has four to five thousand patients each year, most of whom have dysentery (see page 38), there was concern by the Centre and the local community that health services should be maintained. Discussions with the British Overseas Development Administration to establish a health care NGO (see page 38) based on the Centre's existing facilities and staff were begun in 1989 and were approaching a favourable conclusion at the end of the year.

Research

Several research studies were carried out during 1989.

Predicting the risk of dying

Six anthropometric indicators based on weight, height, arm circumference and age, were examined to see which was best at identifying children aged between 12 and 59 months in Teknaf who subsequently died. The indicator with the greatest predictive value was found to be the measurement of arm circumference. The technique is simple and cheap to perform, which makes it an attractive means for easily screening children to identify those most at risk of dying.

Socioeconomic factors, malnutrition, and child mortality

In five villages in Matlab in 1981 a sample of 1,722 children aged 2 to 62 months was identified and studied for 18 months. As expected, severely malnourished children had a much greater risk of dying than better nourished children; girls had a greater risk of dying than boys; and both the mother's education and household economic circumstances were factors related to children who subsequently died. The interaction between these variables is important and implies that if chlidrens' health is to be improved, in addition to trying to improve economic circumstances, females should be educated as well.

The implications of early childbearing on maternal and child health

A new study began in Matlab during 1989 which will examine the effects on maternal nutritional status, on the outcome of pregnancy and on infant mortality of a female's age at menarche, age at marriage and her age at first pregnancy. The sample consists of 1,618 females who participated in a study between 1976 and 1977 when they were 10 to 20 years old. These women have been interviewed regularly by the DSS ever since then, so their current residence, date of marriage, and dates of childbirth are known, and they can be easily located and interviewed. In addition to its scientific promise this study highlights the potential for research using the DSS population registration system.

Impact of mothers' hygiene on the incidence of diarrhoea among their children

Using data collected in the Teknaf DSS area, this study examined the effects on the incidence of diarrhoea during childhood of providing handpump water for drinking and washing, of maternal hygiene, and of removing children's faeces from the yard. Taken together, these relatively cheap and simple interventions reduced the annual incidence of diarrhoea by more than 40%. ■

MATERNAL AND CHILD HEALTH AND FAMILY PLANNING RESEARCH

A Family Planning and Health Services Project was launched in late 1977 in half of the ICDDR Matlab Demographic Surveillance System area (see page 24) with the aim of reducing fertility and child mortality. In 1986 the project was expanded to include more services and undertake a broader collection of data on child health, and so became known as the Matlab Maternal and Child Health and Family Planning (MCH/FP) Project. The existence of the DSS allows the effect of services on one half of the community lying in the Treatment area to be evaluated in contrast to people living in the other half, called the Comparison area, who receive the normal government services.

The Matlab MCH/FP Project: the design, implementation and monitoring of services and the Record Keeping System
Principal Investigators: Vincent Fauveau and Kate Stewart
Funded by: NORAD and WUSC/CIDA
In the MCH/FP Project, health care is delivered during fortnightly home visits by 80 Community Health Workers (CHW). They provide counselling on family planning, nutrition education, a wide range of contraceptive methods, vaccinations, safe birth kits and vitamin A capsules. The CHWs treat children with pneumonia and identify and refer malnourished children for treatment. Mothers and children are also able to receive treatment for diarrhoea and other illnesses at the Matlab Treatment Centre, at the Central MCH clinic, or at four smaller outlying MCH clinics. In addition to providing services, CHWs collect information every two weeks on the provision of services, on the health of children and on the current reproductive status of women. The CHWs are supervised by male Senior Health Assistants who have contacts with husbands and other males in the community, and by female Family Welfare Visitors who provide technical support.

As a result of the programme the Total Fertility Rate in 1985 was significantly lower in the MCH/FP area than in the Comparison area — 4.5 compared with 6.0 children per woman — but this 25% difference was not as large as might be expected considering that 50% of couples in the Treatment area practised contraception. By the same date, infant and child death rates had been reduced by 28% and 37% respectively. In order to decrease fertility and mortality even further it was decided to place particular emphasis from the beginning of 1986 on maternal and child health services. The World Health Organization's comprehensive Expanded Programme of Immunization (EPI) was put into practice and a Nutrition Rehabilitation Unit was set up at the Central Matlab Clinic (see Annual Report 1986).

Based on a comparison of the causes of death among mothers and children aged less than five in the Comparison and Treatment areas, in 1987 the focus of new services shifted towards providing maternal care and treating acute respiratory tract infections (see below).

In 1988 the focus of attention was centred on the quality of care and the quality of data collection. Refresher training sessions were arranged for Community Health workers and their supervisors, and a quality control team was formed to conduct independent, random checks on data, to detect discrepancies or omissions, and to discuss problems with field workers.

Since July 1988, as a part of a national Nutritional Surveillance System now coordinated by Helen Keller International, anthropometric measurements have been taken every three months of a randomly selected sample of 400 children aged between 6 and 48 months. This nutritional surveillance

continued during 1989; other collaborative and cooperative efforts included:

- participation in national workshops on maternal health care, acute respiratory tract infections, and injectable contraceptives.
- collaboration with the Bangladesh Fertility Research Programme which conducted field work in Matlab for a national study to assess the period of follow-up for removal or reinsertion of intra-uterine devices.
- training sessions for midwifery students from the Chandpur Red Crescent Hospital.

In 1989 microcomputers were installed in Matlab to speed up data entry and analysis, and so enable results to be provided quickly to field workers and their supervisors.

Programme statistics show that during the past year 1,600 pregnant women received antenatal care, 890 received postpartum care, and over 200 had a midwife or physician in attendance at the time of delivery. Over 6,000 of more than 9,000 women using contraceptives were seen and over 3,000 women were treated for infections or other medical complaints. More than 90% of all married women of reproductive age received the full course of vaccination against tetanus and more than 3,000 safe delivery kits were given to pregnant women.

At the end of 1989, 92% of children had been immunised against measles, 72% had received three doses of DPT and polio vaccines, about 12,000 children had received treatment at the Matlab clinic (547 as in-patients), and over 180 children were treated at the Nutritional Rehabilitation Unit. During the year about 200,000 packets of ORS were provided in the community by the CHWs and by *bari* mothers — women in a group of households who have a store of ORS which they distribute to their community.

An approach to improving maternity care
Principal Investigators: Vincent Fauveau and Shameem Akhter
Funded by: Ford Foundation
Based on the information provided by a study of maternal mortality in Matlab, a programme of maternity care was started in early 1987 when four professional midwives were posted to two of the MCH sub-centres. The midwives have three main responsibilities:

- to perform home antenatal visits with CHWs whenever pregnant women have been identified, to provide advice and care for minor problems, and to refer mothers with more dangerous problems for specialised help.
- to attend home deliveries with CHWs and traditional birth attendants (TBAs) where they encourage hygienic practices and help when complications arise or arrange for mothers to be transferred to hospital
- to visit homes after childbirth to ensure that both mother and child are well and provide treatment if necessary

In spite of the fact that midwives were available in villages to provide obstetric care, the use of their services was less than expected. A study of mothers who chose to have a midwife in attendance during their delivery in comparison with mothers who did not, showed that women were more likely to call in a midwife if one was posted nearby and if they had received antenatal care.

In an effort to identify mothers most at risk of problems during pregnancy or delivery, from May 1989 CHWs were instructed to complete a form on each pregnant woman in order to identify factors which might help pin-point women requiring special antenatal care. In addition, the possibility of using CHWs themselves to provide maternity care is also being investigated.

The extension of the maternity care project into the remainder of the MCH/FP area will be undertaken in modified form in 1990 when Family Welfare Visitors (FWVs) are posted to sub-centres. The role of both FWVs and midwives will be changed to emphasise the training of CHWs and TBAs in order to generate village credibility and to improve the use of maternity care services. ■

The aim of the next study is to examine within households how decisions are made about maternal health care, who makes them and why people make the choices they do. This decision making process has a profound impact on providing health care services

designed to reduce maternal and infant mortality.

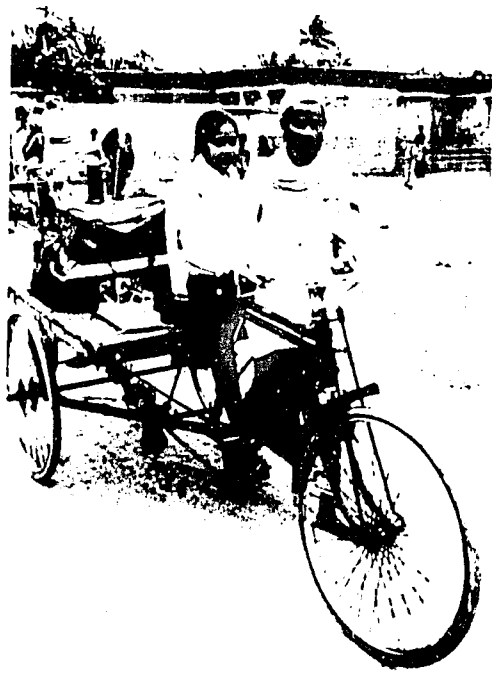
Obstetric decision-making in a pluralistic setting
Principal Investigator: Nancy Stark
Funded by: Fulbright
About 100 households will be visited and women of child bearing age and their other important family members, such as the husband or mother-in-law, will be interviewed. By means of open ended interviews and observation all aspects of reproductive decision making will be documented with a focus on problems with pregnancy and delivery. A sub-sample of pregnant women will be studied throughout their pregnancy and for six weeks afterwards. ■

An investigation of women's experience with IUDs
Principal Investigators: Kate Stewart and Maxine Whittaker
Funded by: NORAD and WUSC/CIDA
This study is being done to understand how rural Bengali women cope with problems they experience while using an intra-uterine device (IUD) as their method of contraception. It is clear that some women cope with the various side-effects and inconveniences of the IUD and continue using them; others switch to another method or no longer practice contraception. It would be helpful to know how women cope with problems and how they differ from women who give up using IUDs. Information obtained from interviews with women will be used to improve counselling, help women to cope with side-effects and provide more support to those using IUDs. ■

During 1989 there was an outbreak of jaundice during which several pregnant women died.

An epidemiological study of jaundice in pregnant women
Principal Investigators: Kate Stewart and Vincent Fauveau
Funded by: NORAD and WUSC/CIDA
The aim of this study was to identify factors which put pregnant women at risk of dying from jaundice. The data being studied include hospital records and laboratory reports of tests on pregnant women with jaundice, cause of death interviews with families of jaundiced women, and questionnaire data from a community case-control survey of risk factors for hepatitis. ■

In 1986 acute respiratory tract infections were responsible for 39% of post-neonatal deaths and for 18% of child deaths. This finding made such infections a priority in efforts to prevent deaths during childhood. In accordance with the recommendations of the WHO, the MCH/FP programme aims to use CHWs and their paramedical supervisors to diagnose and treat children with acute lower respiratory tract infections.



Maxine Whittaker

A rickshaw van being used to transport a Family Welfare Visitor, her infant scales, records and helper to rural villages

The control of acute respiratory tract infections
Principal Investigators: Vincent Fauveau and Kate Stewart
Funded by: The Netherlands
By early 1988 the teaching and practical training of all workers concerning acute respiratory tract infections had been completed, including case definition, case

finding, assessing severity, and the use of injectable penicillin. In half the MCH/FP area CHWs were then instructed to treat mildly and moderately ill children at home, but to refer severely ill cases to sub-centres or to the Matlab clinic. In the other half of the MCH/FP area the CHWs were instructed to refer all children for treatment.

During the first two years of the project 900 children received treatment for pneumonia at home while 972 received treatment at the sub-centre or Matlab clinics. The number of children needing referral from the area where CHWs treated children was less than half the number from the other area. The effects of the project on illness and deaths are still being analysed. A modified form of the project will be established in the whole MCH/FP area in 1990 and will enable the use of oral antibiotics to be evaluated. ■

The aim of this study reported next is to describe how mothers and other caretakers of children understand and explain symptoms and signs of pneumonia in children, what they perceive as the cause, and what actions would take when a child develops pneumonia.

Mothers perception of pneumonia in children
Principal Investigator: Kate Stewart and Barbara Parker
Funded by: The Netherlands
The first phase of data collection was completed in October 1989 and consisted of detailed interviews with mothers of children with pneumonia. The second phase of study is a series of group discussions with mothers, grandmothers, traditional healers, and village doctors concerning the same issues, and will be completed in early 1990.

Preliminary findings indicate tnat mothers are able to identify symptoms of severe pneumonia, including chest indrawing and rapid, laboured breathing. Their understanding is influenced by their experience and by training, and may exist in spite of concurrent beliefs in supernatural causes of disease. Other findings of significance relate to changes in diet during illness and socio-cultural limits to seeking medical care. The results will be used to improve health education. ■

In order to prevent dehydration it is essential to begin giving oral rehydration solution as soon as diarrhoea begins, so mother's must know when to use ORS and how to make it.

Mothers' knowledge and practice concerning diarrhoea and oral rehydration therapy
Principal Investigator: Md. Shafiqul Islam
Funded by: United States AID
This study evaluated the impact of education concerning diarrhoea and oral rehydration, by comparing mothers in the Matlab MCH/FP Project Intervention area with mothers in the Comparison area and in an adjacent Control area. In the MCH/FP Project area certain women called "*bari* mothers" have stores of ORS which they distribute as well as teaching other women how to use ORS and to prepare ORS using salt (*lobon*) and unrefined sugar (*gur*). Community Health workers also distribute ORS in both the Intervention and Comparison areas. In the Control area mothers are visited by Oral Replacement Workers from the Bangladesh Rural Advancement Committee (BRAC) who teach them how to make *lobon-gur* solution.

In the Intervention area 94% of women knew the correct volume of water to use to make oral rehydration solution compared with 80% in the Comparison area and 84% in the Control area. In the Intervention area 78% of mothers gave ORS to "cure or stop" diarrhoea compared with 85% and 68% in the Comparison and Control areas. The use of ORS was greatest in the Intervention area: 78% of mothers reported using it to treat diarrhoea compared with 57% in the Comparison area and 56% in the Control area. ■

The Centre's MCH/FP Extension Project was established in 1982 to carry out research on health and family planning of relevance to policy, and to examine how components of the MCH/FP Programme in Matlab can be used in practice by the health services of the Government of Bangladesh. This type of research has come to be termed "operations research". In addition to undertaking research in Matlab, the Extension Project works in two other upazilas in rural Bangladesh, Abhoynagar and Sirajgonj — the Extension areas.

The MCH/FP Extension Project
Principal Investigator: Michael Koenig
Funded by: United States AID
During 1989 the Extension Project continued its mandate to carry out basic research on

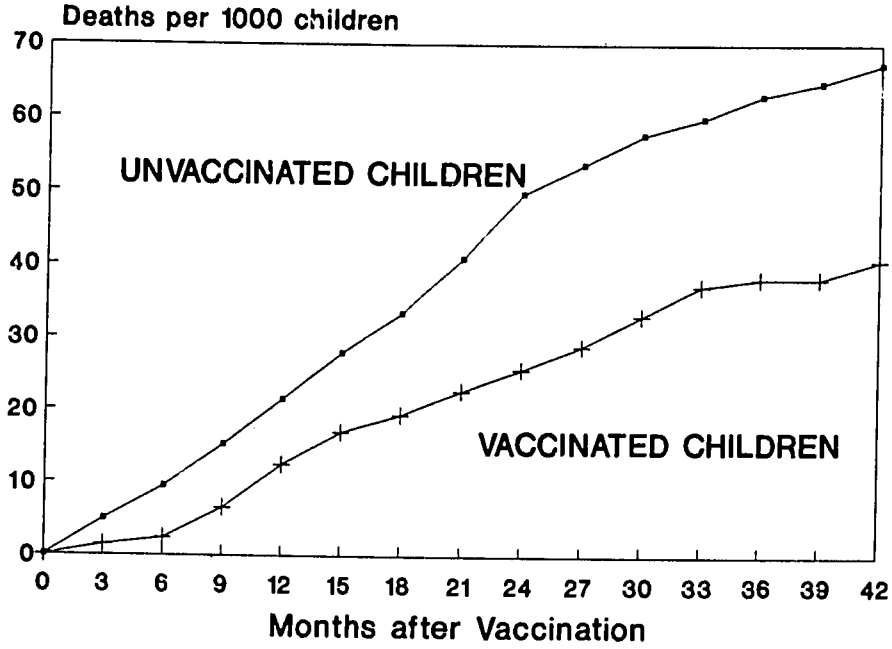


Figure 1
Data collected in Matlab between 1982 and 1985 comparing the cumulative number of deaths over a period of 42 months among 8,135 children vaccinated against measles and a similar number who were not vaccinated. This provides clear and important evidence that measles vaccination can reduce the risk of dying for children aged between 9 and 60 months by as much as 46%

the Matlab and Government health and family planning services, to carry out operations research on aspects of delivering services within the Extension areas, to provide technical assistance to the Government, and to disseminate the findings of the Project.

Family Planning Research in Matlab
The Matlab programme is recognised internationally as an example of how success in family planning can be achieved, even in the absence of extensive socioeconomic development, if services are appropriately designed and intensively delivered. Research continued during 1989 to obtain a better understanding of the changes in contraceptive use which have occurred as a result of the programme, and on its impact upon other aspects of life.

A study of trends in contraceptive use and effectiveness among practising couples in Matlab during the period from 1978 to 1987 found that contraceptive failure rates have tended to increase over time, possibly due to the increasing recruitment of younger couples who were interested in spacing rather than limiting births. This finding provides a partial explanation for the higher than expected fertility of women in the Matlab intervention area given that more that 50% of couples practice contraception.

A separate study used group interviews with CHWs to explore how their employment in the Matlab service programme has influenced their status. It was found that their job has had a strong and beneficial effect upon the CHWs' status within the community: their influence has extended into spheres other than health and family planning, and they appear to have improved the status of women in general by serving as role models for other women within the community.

Current research by the Extension Project is focusing on recent trends in contraceptive use and on family size preferences in the Matlab Treatment and Comparison areas, and

on identifying the underlying factors which may have contributed to any changes.

Impact on mortality of MCF/FP services
Two studies were completed in 1989 on the effect on childhood mortality of vaccination, the first of which was a major study of measles immunisation.

Using data collected in Matlab between 1982 and 1985, the number of deaths among 8,135 vaccinated children was compared with a similar number of children who were not vaccinated. The results shown in Figure 1 indicate clearly that vaccination against measles may reduce the risk of dying for children aged between 9 and 60 months by as much as 46%. This finding indicates the need to give measles vaccination a higher priority within primary health care programmes in developing countries.

The second study used data from Matlab to examine the potential reduction in the number of deaths of infants and children which could be expected to result from immunisation programmes. It concluded that while immunisation programmes are likely to reduce the number of deaths of children aged 1 to 4 years, any impact upon infant mortality is likely to be much smaller.

Current research on child survival in Matlab is examining:

- measles immunisation and the subsequent risk of dying from other causes
- the impact of tetanus and DPT immunisation on childhood mortality
- the extent to which the family planning programme, by changing patterns of childbearing, has contributed to fewer deaths of mothers and children and led to improved health

Microcomputer-based Service Recordkeeping System
The primary activity of the Extension Project in Matlab is to collect, edit and computerise data concerning services provided by the Matlab MCH/FP programme. Information was collected during 1989 about 17,035 women of reproductive age and 14,632 children less than five years old. The information about women concerned contraceptive use, immunisation, reproductive status and the outcome of pregnancy, while for children details of breast-feeding, immunisation, nutritional status, respiratory tract infections and diarrhoeal diseases were recorded as part of the recordkeeping system.

Taking advantage of recent advances in microcomputer technology, work has recently been completed on adapting the RKS to microcomputers based in Matlab itself. This innovative development enables data on services to be provided within two weeks of each monthly cycle of data collection. The recordkeeping system will reduce the costs of data collection significantly, it will enable programme performance to be evaluated rapidly and it will contribute to further improvements in the delivery of services.

Operations Research in the Extension Areas
During the last seven years the Extension Project has undertaken pilot testing and operations research within the government health programme to improve services by:

- increasing the number of female fieldworkers
- expanding the range of contraceptives offered to clients
- moving MCH/FP paramedical care as close to the users' homes as possible
- strengthening management and field supervision
- improving the overall quality of health and family planning care.

The research and recommendations of the Extension Project have contributed to date to a number of important policy decisions concerning the national programme including: the recruitment of an additional 10,000 female fieldworkers; the revision of their training programme to provide a more practical, field-based curriculum; the introduction of a fieldworker recordkeeping system; the establishment of temporary health clinics in unions (administrative units with a population of about 20,000); and the formulation of policies to coordinate NGO and government services more effectively.

The Extension Project continued during 1989 to carry out operations research to test other approaches to improve the delivery of health and family planning services, and continued to work closely with the Govern-

Table 3
Results from 1989 Quality of Care Survey in the MCH/FP Extension Areas

	% Answering always/most of the time		
Women who reported that a field worker:	Sirajgonj	Abhoynagar	Comparison
1. Personally visited her: - At least every 3 months	48.1	74.7	28.5
- Never visited	19.0	6.6	29.0
2. Appreciates her need for privacy	65.7	73.6	51.0
3. Was responsive to her questions	83.5	72.6	41.2
4. Was someone who she could depend upon to solve problems	44.3	41.4	19.0
5. Provided sufficient information	57.1	46.6	28.5

ment of Bangladesh and aid donors to incorporate important findings into national policies. Current recommendations include strengthening the work force of female field-workers to provide health care in clients' homes, expanding the range of services provided, increasing the domiciliary provision of injectable contraceptives, and providing transport for FWVs (see photograph on page 29) to attend clinics set up in the community.

During 1990 and 1991 two subjects will receive particular attention for operations research and field testing: research on improved management in the government programme, and means to improve the quality of MCH/FP services delivered to clients. The results presented in Table 4 of a recent survey of 8,066 rural women in the Extension intervention and comparison areas concerning the care provided by government female fieldworkers, showed that while the clients' perception of the quality of care provided by workers was considerably higher in the Treatment area, considerable scope exists for further improvements in the quality of services in all areas.

The Sample Registration System

The Sample Registration System (SRS) is an innovative system by which the effects of new services being tested in Project field sites can be assessed rapidly. Women in a sample of 8,811 households are interviewed every three months about their contact with health and family planning personnel and about their current use of contraceptives, and information about vital events in the household is also recorded. In addition to providing statistics about service operations and demographic trends, the SRS enables research to be done on other issues concerning operations research, health and social science. In a move similar to the RKS, the SRS has recently been adapted to microcomputers in an effort to improve efficiency and reduce costs.

Several papers on operations research in the Extension areas were published or presented during the year. Two studies examined the effect of visits by fieldworkers on changes in contraceptive use, and found that more contact between fieldworkers and rural women was associated with a greater use of contraceptives and also with a preference for temporary methods of contraception. A study of government female fieldworkers found that the current workload and staffing ratio did not give fieldworkers enough time to provide comprehensive services, a finding which provided support for the Government's decision to increase significantly its force of female workers.

Technical Assistance and Dissemination

The Extension Project has assisted the Government of Bangladesh to implement nationally several of its most important policy recommendations. The Project is currently working with the Government to plan and coordinate the recruitment and training of 10,000 additional female fieldworkers, a process which will be complete by the middle of 1990. In addition, the Government has decided to introduce nationally the fieldworker recordkeeping system which was developed in the Project field sites. Project staff have been providing technical assistance to the Government since 1987 and when the record keeping system is in place it is expected to

contribute significantly to improvements in their delivery of MCH and family planning services.

The findings of the Extension Project are widely disseminated both nationally and internationally by means briefing papers, working papers, meetings, workshops and field trips. Briefing papers on specific topics which summarise key findings are distributed by mail to over 1,200 policy makers and researchers both in Bangladesh and abroad. During 1989, briefing papers were completed on the cost-effectiveness of the Matlab service programme and upon the validity of statistics about services as a means of evaluating family planning programmes.

A major exercise during 1989 was the organization of a national workshop on aspects of delivering injectable contraceptives in Bangladesh which was attended by senior government and NGO programme managers, and by the Minister and the Secretary of Health and Family Planning. The major recommendation of this workshop was to increase the delivery of injectable contraceptives to women in their homes — a service which has been successfully tried by the Extension project in an upazila — with a view eventually to introduce the system nationally. Many donors to Bangladesh, such as the World Bank, UNFPA, the WHO and United States AID, use the findings of Project field research in their efforts to improve the delivery of health and family planning services in Bangladesh. A recent example of this has been the series of briefings held with the World Bank consortium of co-financiers who are planning the Fourth Health and Family Planning Project. ■

Table 4
Fertility and mortality rates from the MCH-FP Extension Project Sample Registration System.

Vital rates (per 1000)	Sirajganj[1]				Abhoynagar[1]				Jessore Comparison Area			
	1986	1987	1988	1989[2]	1986	1987	1988	1989[2]	1986	1987	1988	1989
Fertility												
Crude birth rate	40.1	40.6	41.4	32.6	26.7	29.5	28.6	23.0	36.5	30.9	31.9	27.6
General fertility rate[a]	173.7	176.1	181.1	143.1	110.0	121.6	117.8	93.0	158.4	133.3	137.8	117.9
Total fertility rate[b]	5.4	5.3	5.4	4.8	3.1	3.4	3.2	2.6	4.8	3.9	4.2	3.5
Mortality												
Crude death rate	13.9	13.4	14.6	12.9	10.2	7.8	7.8	8.1	7.7	6.2	7.5	7.7
Infant mortality rate[c]	147.7	149.5	165.5	150.3	136.3	104.0	102.4	112.8	92.3	91.7	79.2	72.0
Neonatal death rate[c]	94.3	92.0	100.2	80.5	88.2	58.4	59.6	64.0	62.9	56.8	45.8	48.0
Post-neonatal death rate[c]	53.4	57.5	65.3	69.8	48.1	45.6	42.8	48.8	29.5	34.9	33.3	24.0
Age specific death rates:												
- 1–4 years	22.9	18.1	21.4	16.0	9.1	4.6	8.0	4.4	6.4	6.7	3.0	5.3
- 5-14 years	2.0	2.6	1.5	2.3	1.5	0.6	1.4	0.5	0.5	0.5	2.4	1.2
- 15-44 years	2.7	2.0	2.5	2.0	2.0	2.5	2.6	3.2	2.2	1.5	2.4	2.1
- 45 + years	23.5	24.5	25.5	32.2	30.6	20.3	17.2	22.9	17.9	12.9	20.3	26.2

[1] Includes both treatment and comparison areas.
[2] Four unions in Sirajganj and two in Abhoynagar were dropped from the Project late in 1989.
[a] Per 1000 women of child–bearing age; [b] Per woman; [c] Per 1000 live births

PROVIDING HEALTH CARE

The ICDDR operated three hospitals during 1989, in Dhaka, Matlab and Teknaf, where free treatment for diarrhoeal diseases were provided. The hospital in Dhaka is the main facility for clinical research as well as for treatment.

Clinical Research Centre, Dhaka
Funded by: DANIDA and core support
During 1989 a total of 60,083 patients with diarrhoea came to the Clinical Research Centre for treatment, a decrease of 27% compared with 1988, but only 6% fewer patients were admitted to the wards — 6,135 in 1989 compared with 6,540 in 1988. This reflects a rise from 7.9% to 10.2% in the proportion of patients admitted to hospital. The decrease in the total number of patients compared with the previous year probably resulted from the fact that the floods of 1988 swelled the total number of patients requiring treatment, but the increase in the percentage admitted may be due to the greater severity of illnesses seen during 1989.

Of the 5,765 patients admitted to the general wards, 21.6% were treated in the intensive care unit at some time during their stay, a drop of 13.4%. A total of 4,411 patients, 7.3% of those who came for treatment, took part in research studies. This figures includes over 2,000 people who agreed to take part in the Diarrhoea Surveillance System (see page 21).

Microbiological culture of faecal samples was performed on samples from the 6,135 patients admitted to the wards in order to identify bacterial pathogens responsible for diarrhoea. Species of *Shigella* were isolated from 17.7%, an increase of 1.7% compared with the previous year while *Vibrio cholerae* O1 was isolated from 5.1% of samples, an decrease of 46% in the proportion of *V.cholerae* compared with 1988. No bacterial pathogen was isolated from 72% of faecal samples. The proportion of isolates of *S.dysenteriae* type 1 which were sensitive to nalidixic acid, the drug of choice for treating shigellosis, dropped from 65% to 31% although the *S.flexneri* isolated were sensitive to the drug. The majority of isolates of all species of *Shigella* were resistant to ampicillin and cotrimoxazole.

The case fatality rate among patients admitted to hospital during 1989 was 6.6%, but this includes 49 patients who were dead on arrival or who died soon after. If these cases are excluded, then the death rate among all patients who came for treatment was 0.68%. The death rate associated with shigellosis was 8.7% compared with 11% in 1988. This reduction in rate by 2.3% represents a 20% decline.

A total of 26,583 litres of intravenous fluids were used during 1989, 20,559 litres (42.7%) less than in 1988 while 336,513 litres of ORS was required during the year, 9% less than in 1988. However the average volume of ORS used per patient was 5.6 litre/patient compared with 4.5 litres/patient in 1988. ■

Child Health Programme
Funded by: DANIDA
The main aim of the Child Health Programme (CHP), which began work in December 1987, is to initiate, expand and strengthen the Centre's primary health care activities. The work of the CHP includes vaccinating mothers and children, providing nutritional rehabilitation to malnourished patients, offering family planning to women, educating patients and mothers attending their children about health matters, and training health workers.

Health Education
Nearly all patients at the Clinical Research Centre and their attendants are given health education. The topics stressed are: preventing and treating diarrhoea, immunisation, nutrition, stimulating children, and birth spacing by family planning. The health education is given both in groups and individually, while film shows are followed by group discussions.

CHILD HEALTH PROGRAMME

During 1989 105,400 patients and attendants participated in group health education.

The CHP has been actively involved during the year in preparing the posters, logos and messages used in the campaign to promote breast-feeding coordinated by UNICEF. The national breast-feeding poster produced by the CHP is shown opposite.

Immunisation
Immunisations according to the guidelines of the Expanded Programme of Immunization in Bangladesh are offered in the Centre from 7:00 a.m. to 7:00 p.m., seven days a week. Approximately half of the children up to 2 years old who are brought to the Centre's hospital were found not to have been immunised against diphtheria, pertussis and tetanus (DPT vaccine) or against polio, measles and tuberculosis. Of the 14,391 children vaccinated during 1989, 85% were given the first of the three doses of DPT required for immunity, 40% returned for the second dose and 27% came back for the third. In addition, 44% of women of child bearing age were vaccinated against tetanus: 10,665 women received the first dose of tetanus toxoid while 12,719 a booster dose.

Nutritional Rehabilitation
The CHP offers both in-patient and out-patient nutritional rehabilitation services, and children are also visited at home. In 1989, 276 severely undernourished children were admitted to the nutritional rehabilitation unit while from July to December 1989, there were 1,279 children visited the out-patient unit. Tuberculosis out-patient services were also offered during the year in close cooperation with International Medical Cooperation Committee Associate International Research Fellows and 25 patients were successfully treated for tuberculosis while 28 were still under treatment.

A sewing and knitting workshop for the mothers and female attendants of children in the unit was started using an urban volunteer (see UVP report on page 22) as a trainer. Her travelling expenses are met by the Women's Voluntary Association.

Birth Spacing and Family Planning
During the last few months of 1989 the CHP started to offer family planning services, mainly to parents of children admitted to the nutritional rehabilitation unit. The main method of choice was an injectable contraceptive, but pills, IUDs and condoms were also offered. ■

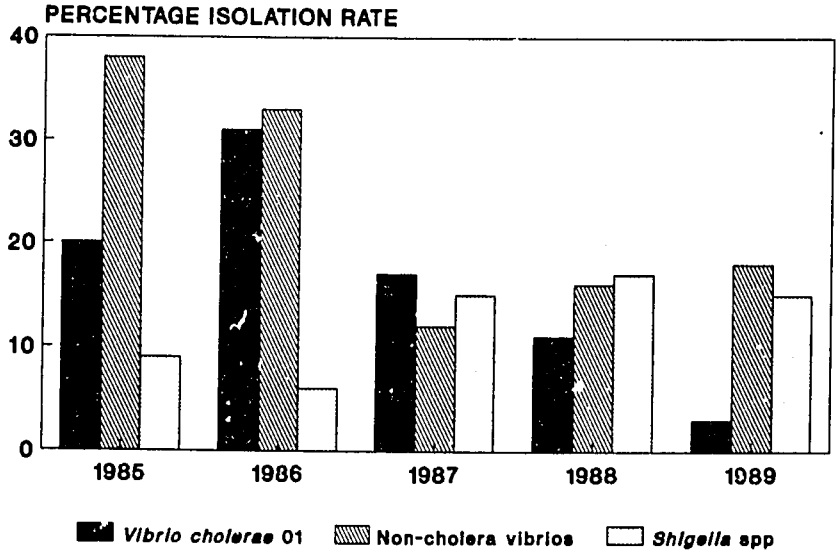
Since 1963 the ICDDR has operated a field station in Matlab upazila, a rural area about 60 km south-east of Dhaka. The Centre runs a 60 bed diarrhoea treatment centre and three community operated treatment centres, as well as undertaking demographic surveillance of about 200,000 people in 142 villages (see DSS, page 24) many of whom benefit from a comprehensive Maternal and Child Health and Family Planning Programme (see page 27). The Centre also undertakes field research on diarrhoeal diseases and malnutrition in the area.

Matlab Diarrhoea Treatment Centre
Funded by: WUSC/CIDA
During the year 5,371 patients received free treatment for diarrhoea at the Matlab Treatment Centre of whom 47% came from within the DSS area. The case fatality rate was 0.8%. Another 2,118 patients with diarrhoea were treated at three Community Treatment Centres run by volunteers trained and supported by the ICDDR; only 5 patients died, a case fatality rate of only 0.2%.

Stool specimen from 2,527 patients who lived within the DSS area were cultured and yielded two main pathogens: species of *Shigella* (16%) and non-cholera vibrios (18%). Figure 2 shows that *Vibrio cholera* was isolated from only 3% of patients during 1989, a sharp decline compared with previous years, while the isolation rate of non-cholera vibrios has dropped by half since 1985. The most common species of *Shigella* isolated during 1989 was *S.flexneri* (48%) followed by *S. dysenteriae* type 1 (31%). Figure 3 shows that most of the isolates of *S.dysenteriae* type 1 tested during the year were resistant to ampicillin and cotrimoxazole, and that nearly 50% of isolates were resistant to nalidixic acid. Other species of *Shigella* were still sensitive to nalidixic acid (not shown). *Giardia intestinalis*

PHOTOGRAPH OPPOSITE: a poster produced by the Child Health Programme to promote breast-feeding.

Figure 2
The percentage of stool samples from which the three main causes of diarrhoea were isolated over the last five years in Matlab.



and *Entamoeba histolytica* were detected in only 5% and 1% respectively of the 4,299 faecal samples examined microscopically.

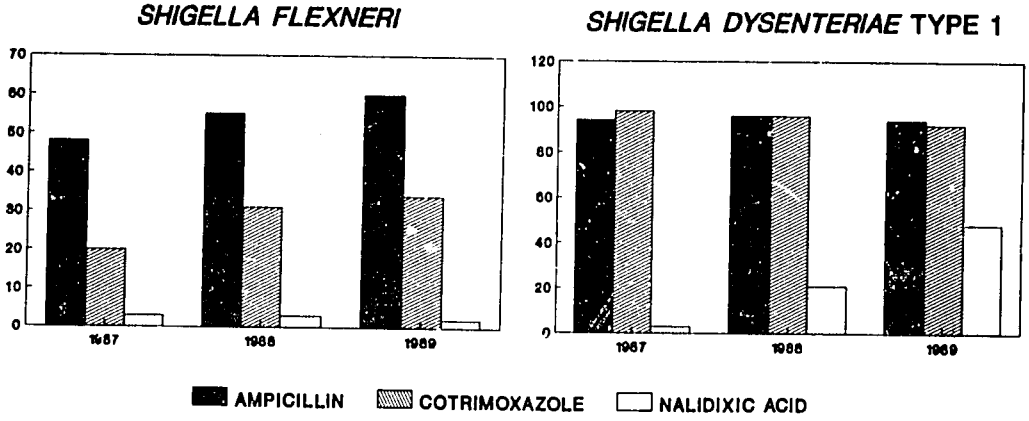
At the end of 1989 building work had almost been completed on the new ICDDR health centre. The ICDDR had been sharing the facilities of the government health complex in Matlab until financial assistance from the United Nations Capital Development Fund and support from the Government of Bangladesh enabled the construction of a two-storied building with a floor area of 3,250 square metres. The new building will provide facilities for medical care, training and research and will open officially in early 1990. ■

In 1974, after a serious epidemic of shigellosis in the extreme south of Bangladesh, the ICDDR opened a field station in Teknaf, near to the Burmese border. A demographic surveillance system was set up based on the one in Matlab (see page 21) and research on the transmission of shigellosis commenced.

Teknaf Treatment Centre
Funded by: DANIDA
The ICDDR operates three free treatment centres in Teknaf, at Subrang, Shahpuridwip and in Teknaf itself. The number of patients seen during 1989 and the previous 4 years are shown in Table 5 with the main pathogens isolated from faecal samples and the volumes of ORS and I.V. fluid used. Dysentery due to species of *Shigella* remains a major concern and a greater proportion of patients with shigellosis were treated in Teknaf than in Matlab or Dhaka during 1989.

Future Plans
The Board of Trustees of the ICDDR decided at one of their biannual meetings to close the Centre's facilities in Teknaf at the end of 1989. Because the closure would leave the local community with little health care, after discussions with local community leaders and aid donors it was decided to form an organisation to continue clinical services and promote rural development. For this purpose the Society for Health, Extension and Development was registered with the government and aid agencies were approached to help with funding. The ICDDR will be supporting the new Society by assigning staff, leasing property and by collaborating in research. ■

Figure 3
The percentage of drug resistant isolates of *Shigella flexneri* and *S.dysenteriae* type 1 over the last three years in Matlab.



The Epidemic Control Preparedness Programme (ECPP) was established to provide technical assistance to the Health Services of the Government of Bangladesh to help control epidemics of diarrhoea and to train government health personnel to be able to respond to epidemics. The funding of the project ended in August 1989.

Epidemic Control Preparedness Programme
Funded by: The Ford Foundation
Between 1985 and 1989 the ECPP trained a total of 677 health personnel including 59 medical officers who were given 6 months training in diarrhoeal diseases, and 51 district laboratory technicians. This training has enabled the Government to begin a National Diarrhoeal Disease Control Programme and the 20 district diarrhoeal disease control units which recently became operational are run by ECPP - trained medical officers.

In addition to training health personnel, since 1985 the staff of the ECPP visited the location of 344 outbreaks of diarrhoea throughout the country and treated over 32,000 patients. The epidemiological investigations carried out at the sites of epidemics has provided a valuable insight into diarrhoeal diseases in Bangladesh. During 1989 the staff of the ECPP investigated seven outbreaks of diarrhoea in rural districts and identified for the first time an outbreak of *Vibrio cholerae* 01 caused by strains resistant to different drugs.

Table 5
Clinical services and the results of micro-biological culture in Teknaf, 1985 to 1989

	1985	1986	1987	1988	1989
No. of patients	3,631	5,565	6,240	3,957	5,079
Deaths	1	9	6	6	9
Patients treated for more than 12 hrs	36	252	258	197	274
Watery diarrhoea	1,152	1,780	1,203	1,065	1,569
Dysentery	2,253	3,572	4,624	2,486	3,471
All others	226	213	413	406	39
No. of stools cultured	3,405	5,310	5,684	2,920	3,591
Vibrio cholerae isolated	24	201	83	181	93
Shigella spp isolated	833	1,724	2,974	1,312	1,723
S.dysenteriae type 1	198	533	1,970	612	902
S.flexneri	590	1,166	957	637	780
Other Shigella spp	45	25	47	63	41
ORS used (litres)	6,915	12,550	11,223	7,912	8,328
I.V. fluid used (litres)	557	823	321	364	322

The project has established the effectiveness of temporary field centres as a means of providing life saving care in rural areas during epidemics of cholera and shigellosis. The staff of the ECPP have conducted interviews with relatives of over 1,000 people who died during epidemics, information which will provide insight into the causes of death during epidemics and may enable new ways and means of preventing such deaths to be developed.

The Government of Bangladesh has requested the ICDDR to continue their technical assistance for a further three years to consolidate the National Diarrhoeal Disease Control Programme. ■

SUPPORT FOR SERVICES AND RESEARCH

The Laboratory Sciences Division is responsible for all routine laboratory tests in the ICDDR concerned with diagnosing pathogens, testing patients and investigating the processes of disease. The expansion of tests and services during 1989 came about largely as a result of the recent establishment of new laboratories, particularly in the fields of clinical immunology, virology, parasitology, enteric bacteriology and molecular biology. However, basic diagnostic tests for medical care and research studies continued to be provided by the Clinical Laboratory Branch, based in the Dhaka Treatment Centre, which performs bacteriological culture of faecal samples and tests the organism isolated for their sensitivity to antibiotics, and analyses blood and other body fluids. The Laboratory also offers its services, often free of charge, to many national institutions and other hospitals. Organisations served during the year include the Institute of Post Graduate Medicine and Research (IPGM&R), the Institute of Public Health, the Bangladesh Rural Advancement Committee and the Dhaka Shishu (Children's) Hospital.

Nearly 36,000 specimens were tested by the Pathology, Biochemistry and Microbiology sections of the Clinical Laboratory during 1989, of which 18,008 were stools or rectal swabs and 11,662 were blood samples. A total of 66,544 tests were performed on these samples. Of 16,067 faecal specimens submitted for bacteriological culture, species of *Shigella* were isolated from 14.1% and species of *Aeromonas* from 7.3%. Fewer faecal samples were cultured for *Campylobacter* spp (5,392) but 17.8% of specimens were found to be infected. An ELISA to detect rotavirus was performed on 3,314 specimens and 21.4% were positive. *Giardia intestinalis* and *Entamoeba histolytica* were found in 4.3% and 2.5% respectively of the 17,948 faecal samples submitted for microscopical examination. Finally, oocysts of *Cryptosporidium* were seen in 5.5% of 822 faecal specimens stained and examined.

The computerisation of results from the Clinical Laboratories in Dhaka, Matlab and Teknaf continued during the year with the design of forms to record data on biochemistry and microbiology tests. Completed forms are sent to the Laboratory Information and Archive Unit, which in 1989 was responsible for entering nearly 100,000 laboratory records into the computer database. By the end of the year the number of records on computer had doubled, providing a huge amount of data for analysis.

The reorganisation of the Laboratory Sciences Division continued during 1989 and Logistic Support Branch was created which combined the media, sterilising and I.V. fluid sections, the pathology and biochemistry units of the laboratory in Matlab, and the antisera production and freeze drying units in Dhaka. Just over 5,000 litres of culture medium were produced during the year, about 20,000 bottles of sterile water, dextrose or minerals were prepared for intravenous injection, 250 ml of antiserum to *Vibrio cholerae* was raised, and over 2,000 ampoules of bacteria were freeze dried for storage. The Branch also provided media and intravenous fluid to many national organisations during the year including Dhaka University, the Institute of Public Health and the IPGM&R.

The Histopathology Laboratory provides services for routine patient care at the Clinical Research Centre in Dhaka and performed 10 necropsies during 1989 on patients who died of diarrhoea. During the year an immunoperoxidase staining technique was set up to identify IgA containing lymphocytes in sections of lymph nodes. It is planned to use this technique in the future to identify microbial antigens in tissue sections. Consultation and referral services for 200 biopsy and cytology specimens were provided to patients of Kumudini Hospital, Mirzapur as well as to patients of other hospitals and clinics around Bangladesh. The laboratory also provided services in support of animal

experiments carried out by several investigators.

The Biochemistry and Nutrition Branch performs specialised, occasional tests on a wide variety of samples including urine, blood and stools. During 1989 11,056 assays were performed on 6,244 specimens, a 64% increase in the number of assays compared with 1988. All the results of tests are now stored on a computer installed in the laboratory. A new assay for C-reactive protein was developed for the COBAS BIO Centrifugal Analyser and two viscometers and a ballistic bomb calorimeter were installed. Amylase rich flour was prepared and tests on the thinning effect of the flour were performed in preparation for a research study which will use traditional methods of food preparation to develop energy dense weaning foods.

The Medical Illustration Cell became part of the Laboratory Sciences Division during the year. Its staff prepare charts, graphs, illustrations, slides, photographs, lettering, posters, logos and designs and provide audio-visual services. The staff of the Bioengineering Cell provide mechanical and electrical repair for specialised equipment or install new scientific equipment. The Animal Resources Branch raises and houses animals for research and tests by the Centre's scientists and for national institutions such as Dhaka University, the Institute of Public Health, the Bangladesh Agricultural University, the National Institute of Preventive and Social Medicine and the Livestock Research Institute.

Several new laboratories were established during the year which, as a part of their research activities, will be able to provide specialised tests and diagnostic services. The Immunology Laboratory has established techniques for assessing cellular immune function — tests which will allow estimates of the ability to combat disease. Techniques to assess neutrophil and lymphocyte function have been established and lymphocyte phenotyping can now be done using monoclonal antibodies. Work is now underway to establish values for normal people in Bangladesh.

A Molecular Biology Laboratory has been established to study at the molecular level organisms which cause diarrhoea. The techniques which are being used include restriction analysis of plasmids and genomic DNA, Southern and northern blotting and cloning of DNA fragments. Several DNA probes have been obtained and are now being used to diagnose pathogenic strains of *E.coli* (see page 7) and different serotypes of rotavirus (see page 9) in collaboration with the new *Virology Laboratory*. The *Parasitology Laboratory* has established the technique of isoenzyme electrophoresis of isolates of *Entamoeba histolytica* which will make it possible to distinguish between pathogenic and non-pathogenic strains. Serological tests for amoebiasis are now being developed.

The Statistical Cell was formed in 1989 to provide statistical consultation for the Centre's scientists and to train junior research staff. The staff of the Cell have provided expertise in designing experimental studies, determining sample sizes, developing and testing statistical studies and interpreting statistical data. The same services have also been provided to scientists working in several national institutions including Institute of Post Graduate Medicine and Research, the National Institute of Population Research and Training, and to students of Dhaka and Jahangir Nagar Universities. The staff of the Cell have reviewed statistical aspects of research proposals and papers submitted to the *Journal of Diarrhoeal Diseases Research* (see page 45). Finally, the staff of the Cell have been asked to collaborate with the proposed Bangladesh population census in 1991.

The Data Archiving Unit (formerly the Data Management Branch) provided assistance to 15 scientific studies during the year, primarily by extracting files from the Centre's archives and helping researchers to use them. These studies ranged from research on family size preference, nuptiality in Matlab and measles surveillance, to helping Centre staff and local university students to identify data sets for thesis research. Data from projects which ended during 1989 and from researchers who left the Centre during the year were added to the archives.

1989 was a year of consolidation for the Computer Information Services (CIS). The rapid growth of the last few years was consolidated to put the resources acquired and developed into more effective and efficient

use. CIS staff were heavily engaged during the year in tuning the newly installed Operating System VM 5.0, its associated software and peripherals. The Resources Accounting System was improved significantly to produce reports that were more useful for computer users to control and so plan future computer usage. A significant amount of time was spent during the year training computer users as well as training CIS staff.

In spite of plans reported in last years' Annual Report, the IBM System 34 mainframe computer could not be withdrawn from use during the year because of the heavy workload of the Centre's finance and administration offices. In addition the time spent on work converting from the System 34 to the new IBM 4361 mainframe was significantly more than predicted due to additional work recommended by consultants commissioned by United States AID. However, the work has progressed well enough to allow the System 34 to be withdrawn from use by early 1990.

During 1989 most of the major users of the CIS facilities such as the Finance Office changed from doing data entry off-line to data entry on-line, resulting in a more efficient detection of errors. The new Inventory Accounting system for the Finance Office was almost completed. Other users such as the MCH/FP Extension Project and the Urban Volunteer Programme continued to use the Computer System extensively. Help with programming was provided to 12 smaller projects.

The DSS (see page 24) continues to be the biggest user of the computer resources with 51% of usage, followed by the MCH-FP Extension Project (17%), the UVP (13%) and then the Finance Division (9%). A total of 120 users kept the mainframe busy for 26 thousand hours during 1989, occupying the CPU for 985 CPU hours with a usage rate of 62%. About 2.5 million records for various projects were entered and verified during the year.

Three new Trainee Programmers were recruited and began one year of training with the branch. The CIS offered courses on SAS, SPSS, Lotus 1-2-3, Dbase III and COBOL for the Centre's staff during the year while many organisations such as Dhaka University and the Water Development Board used the Computer Services of the Centre. Technical services were provided to other local organisations. ■

THE DIARRHOEAL DISEASES INFORMATION SERVICES CENTRE

The ICDDR has a clearly stated mandate to disseminate knowledge concerning diarrhoeal diseases. In view of the Centre's expanding information services, a review in 1988 of the Library and Publication Branch recommended that the Branch should be reorganised and renamed, so in April 1989 the Diarrhoeal Diseases Information Services Centre came into being, to be known by its shortened acronym, DISC. Briefly the three sections of DISC are: Information Services, concerned with the Centre's library; Support Services, concerned with database management, desk-top publishing, membership services, sales and photocopying; and Publication Services, concerned with printing, promoting and distributing all publications. The services offered by DISC include literature searches, bibliographic services and answering specific queries about diarrhoeal diseases. Anyone interested in making use of these facilities should contact the Head of DISC at the address given in the front of this report.

In addition to the long term financial support since 1982 from the International Development Research Centre (IDRC), DISC has received substantial support for the last two years from Swiss Development Cooperation (SDC). The first phase of SDC support ended in December 1989, although support for a further three years is being negotiated, while the IDRC's support will continue until April 1991.

Major developments

The new funding has enabled the DISC offices and library to be renovated. Better lighting and a false ceiling were put in, and an improved air-cooling system was installed to help preserve books, journals and equipment from damage by heat and dampness. Two new photocopiers were purchased and three more personal computers were obtained: one with a high definition screen for desktop publishing and one for use with a CD ROM player. The CD ROM is the first in Bangladesh and has allowed access to a huge volume of material now available on compact discs, including bibliographic databases. The first of these databases, MEDLINE, was obtained on subscription, while the POPLINE population database containing 164,000 references was provided by the John Hopkins University Population Information Program. Literature searches can now be done by anyone using the library; 48 searches had been requested by the end of the year.

The desk-top publishing system installed has allowed the Centre's publications such as *Glimpse*, the Annual Report and the *Journal of Diarrhoeal Diseases Research* to be produced in house, in a form ready to send directly to the printers.

Information Services

This section of DISC serves scientists, physicians and others working at the Centre by providing books, journals and other reading materials and information services. Its services are also available to individuals as well as to libraries, and to organisations both within and outside Bangladesh. Here are some statistics concerning services provided during 1989:

- there were 9,393 visits by readers other than the Centre's staff
- 469 new books were procured during the year, of which 243 were purchased and 226 donated by the Asia Foundation, the Belgian Administration for Development Cooperation, the British Council and other sources
- 229 journals were subscribed to while 168 were received either free of charge or on an exchange basis
- 43 computer database searches were received
- 27 reprints were provided by the Nuffield Library and the British Medical

Association, while 15 reprints were received directly from the authors and from other sources
- over 100,000 photocopied pages were provided
- 18,815 items were loaned
- 3,530 items were provided on inter-library loan to national institutes and organisations
- 653 duplicate items were given to national institutions and organisations of Bangladesh.

Publications

The new desk-top publishing system has allowed the *Journal of Diarrhoeal Diseases Research* (JDDR) to be published more speedily, and in order to get up to date four double issues were published during the year. It will now be possible to publish articles submitted for publication within six months of receiving them, if they are acceptable after peer review.

Eight issues of *Glimpse*, the Centre's newsletter, were published during 1989 to highlight research in progress at the Centre and to provide abstracts of the Centre's publications, news on forthcoming meetings and conferences, news on research on diarrhoeal diseases in Asia, and news about the activities of DISC.

During 1989 a total of 37,387 copies of ICDDR publications and brochures were sent and distributed to scientists, libraries, and organisations throughout the world including: 30,002 copies of *Glimpse*, 2,844 copies of the 1988 Annual Report, 2,257 copies of the *Journal of Diarrhoeal Diseases Research*, 868 copies of other scientific publications, 289 copies of specialised bibliographies, 1,000 copies of brochures about DISC, the JDDR, the ICDDR and other publications, and 127 reprints of ICDDR external publications. In 1989, in addition to 256 annual subscriptions (and DISC membership fees) received for the JDDR (for 1988, 1989 and 1990), 470 individual copies of the JDDR, annotated bibliographies, the directory of Asian diarrhoeal disease scientists, and other internal publications were sold.

A 316-page *Bibliography on Diarrhoeal Diseases: Review Articles and Selective Studies* was published which includes citations and abstracts of 665 papers and publications. Work on the bibliography about studies undertaken in Matlab was completed; when it is published will include citations and abstracts of papers and publications from 1964 to 1989. Work commenced on compiling a supplement to the two annotated bibliographies on ORS and ORT published in 1985 entitled *Oral Rehydration in Diarrhoeal Diseases*. The scope of the *Annotated Bibliography of Asian Literature on Diarrhoeal Diseases* was expanded from March 1989 to include important literature from sources worldwide, and its title was changed to *Bibliography on Diarrhoeal Diseases*.

Twenty issues of the *Current Awareness Service Bulletin*, a broadsheet which lists papers published in journals concerning the Centre's research interests, were produced during the year. And in a new development to keep the Centre's scientists and physicians informed, a twice weekly list of journals received by the library has been produced since June 1989. ■

TRAINING AND STAFF DEVELOPMENT

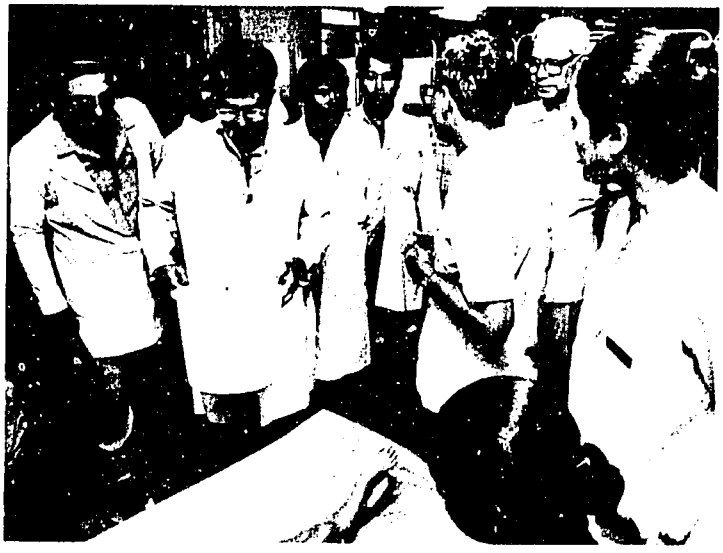
Two of the Centre's aims and objectives are to provide facilities for training Bangladeshi and other nationals, although it has no mandate to award degrees, and to undertake a systematic staff development programme. As in previous years the Centre's training programme has organised national and international courses, offered fellowships, participated in workshops and organised seminars. During 1989 a total of 647 scientists, physicians, health administrators, health personnel, trainers and students from 16 countries received training at the Centre.

Training: International courses
Five international training courses were held during the year attended by 55 participants from 10 countries. Their fees, travel and living expenses were provided by grants from CIDA, Japan, the ICHF, UNICEF and the Aga Khan Foundation.

Fifteen physicians, nurses and diarrhoeal disease control programme managers from Bangladesh (4), Ethiopia (3), Sudan (3), Uganda (3), and Tanzania (2) attended a course on the "Clinical Management of Diarrhoeal Diseases". This course was designed to provide participants with the skills necessary to diagnose and treat diarrhoea in both hospital and in the community. In addition, the participants were taught how to organise courses for health personnel in their own countries.

At the request of the UNICEF office in Beijing, a course on the epidemiology of diarrhoeal disease was organised for four doctors from China. The course provided the skills necessary for undertaking epidemiologic investigations including identifying risk factors for diarrhoeal disease, developing effective preventive measures, statistical analysis using computer and interpreting field data. In addition they also learned new methods to diagnose causes of diarrhoeal disease.

A five day course on diarrhoeal diseases was organised for 18 nurse educators from Nursing Schools in Nepal. The objective of



Asem Ansari

The type of bed used at the ICDDR for patients with diarrhoea is called a "cholera cot": it has a hole in the middle and a bucket underneath. This basic but functional arrangement allows the patient to pass stools whenever necessary and while lying down. Examining the type and consistency of stools is an important clue to the cause of diarrhoea and thus to its treatment. The participants in a course on the clinical management of diarrhoeal diseases shown here are being taught to examine the contents of buckets.

this course sponsored by the ICHF was to provide appropriate knowledge and skills for the management of diarrhoeal diseases to enable the participants to improve nursing practices at home.

A workshop on "Clinical Research Methods in Diarrhoeal Disease" was attended by twelve of the Centre's medical staff and one participant each from Pakistan and India. The course provided the participants with the knowledge and skills to undertake clinical research investigations.

A trainers' training course on the "Use of the Media in the Management of Diarrhoeal Disease" was organised for four participants from China. The course provided the participants with expertise in using different communications media to broadcast information about diarrhoeal disease and they were also given assistance in developing a project proposal.

Training: national courses and specialised training

In 1989 the Centre organised nine full scale national training courses. Two course were organised in collaboration with the Government of Bangladesh and the WHO to support the national diarrhoeal diseases control programme. The courses were designed to provide knowledge and skills to the doctors and nurses who will be responsible for setting up and running diarrhoea treatment and training units at medical college hospitals. The objective of these course were to: train physicians and nurses to treat diarrhoea; to prepare participants to improve case management practices; and to prepare participants to establish diarrhoea training units.

The two courses for post-graduate students from the Institute of Post-Graduate Medicine and Research were designed in the context of the curriculums for the Doctorate of Child Health and for the Fellowship of the College of Physicians and Surgeons to provide theoretical and practical knowledge of treating patients with diarrhoea of different causes and complications.

The broad objectives of the four courses organised for the field supervisors of the Bangladesh Rural Advancement Committee were to provide knowledge about diarrhoea as a major health problem in Bangladesh and its impact on health and well being, and to treat patients with different degrees of dehydration.

A course on the use an applications of the CDS/ISIS Library Information System was organised with financial assistance from UNESCO-PGI, Bangkok. The course was attended by 18 participants: 13 from 11 national institutions and five from the ICDDR and CIRDAP.

During the year a series of one and two day courses were provided to 370 students from Bangladesh medical colleges and other government and non-government institutions on management of diarrhoea using ORS.

Specialised training was provided to three physicians from Dhaka Shishu Hospital on treating children with diarrhoea and the complications of diarrhoea.

Eighteen students from Jahangir Nagar University were given instruction in the Clinical Pathology Laboratory on biochemistry laboratory techniques and quality control. A course on identifying *Vibrio cholerae* was arranged at the request of the Director of the Institute of Public Health for Associate and Assistant Professors of eight Bangladesh medical colleges.

Six students from Dhaka University used the Centre's mainframe computer facilities during their Master's degrees and received assistance from the staff of the CIS (see page 42).

Training: the Fellowship Programme

The objectives of this programme are to develop specialised skills and to provide Fellows with an insight into research methods. The Fellows work either in current research studies or develop research protocols themselves in collaboration with their preceptors. During 1989 twenty-nine Fellows, researchers and health professionals from 9 countries studied at the Centre for periods varying from few week to a year.

Training: the SAARC Fellowship Programme:

In 1989 the Centre continued to offer fellowships to the countries of the South Asia Association for Regional Cooperation (SAARC). Two Fellows, one from the Maldives and the

other from Bhutan, underwent training. The fellow from Maldives was mainly trained in techniques of Clinical Microbiology to isolate and identify the most common pathogens causing diarrhoea. The Fellow from Bhutan was provided theoretical and practical training in current practices in treating diarrhoeal diseases and in doing research.

Training: Government Fellowships
At the request of the Directorate General of Health Services of Bangladesh made through the Programme Coordination Committee (see page 54), the Centre offered eight Fellowships for intensive training on the clinical management of diarrhoeal diseases, one each to the eight medical colleges. In addition the Fellows were also introduced to the epidemiology of diarrhoeal disease and to laboratory aspects of diarrhoea.

Training: post-graduate students
A formal agreement was reached during the year between the ICDDR and the University of Dhaka under which the Centre will provide facilities and supervision for post-graduate students to undertake research for higher degrees. These opportunities have been offered to other educational institutions in Bangladesh as well. In 1989 twenty students worked at the Centre, many of whom presented the results of their work in seminars, and seven gained degrees.

Training the Centre's teachers
A training course was conducted in collaboration with the WHO to familiarise the Centre's trainers with the WHO Diarrhoea Training Unit Directors Guide and the associated teaching materials, and on the methods of teaching used in the WHO course on the Clinical Management of Acute Diarrhoea. The course will enable the Centre's staff to teach these WHO courses and later in the year two national training courses were organised.

Training: an evaluation
As the Centre's training programme has been functioning for ten years it was decided that the use and effectiveness of the training course should be evaluated. With financial assistance from CIDA and Japan, two countries in Asia (Indonesia and Thailand) and two in Africa (Tanzania and Zimbabwe) were visited to examine how a sample of former participants in ICDDR courses were involved in the control of diarrhoeal diseases and to examine the status of diarrhoea disease control programmes in these countries.

The evaluation involved the use of questionnaires, field visits and discussion with local diarrhoeal disease control personnel. The evaluation teams visited the headquarters of each national Diarrhoeal Disease Programme, medical colleges, provincial and district hospitals, peripheral health centres, and even some local households.

In every country visited diarrhoea is a major health problem and is the first or second most important cause of death for children younger than five. The diarrhoeal disease control programme in Indonesia was very advanced, but it was felt that in other countries the programme required further emphasis. In all countries visited it was considered that laboratory aspects of diarrhoeal diseases required strengthening.

The review teams found that between 35% and 50% of the Centre's former students were directly involved with their national control of diarrhoeal diseases programme, some of them were running diarrhoea treatment units and, as well as providing treatment, were also responsible for training people. All the former students interviewed said that their training at the ICDDR had been useful and effective, but some suggested that the prevention of diarrhoea and persistent diarrhoea should be given more emphasis.

Training: seminars
To provide opportunities for an exchange of information and views, sixteen seminars were organised during the year in which both resident and visiting scientists presented talks on diarrhoea and other topics.

Staff development: a summary
The ICDDR has a vigorous staff development programme aimed at improving the skills of staff to sustain current research and to create well-trained staff to meet future needs. This is accomplished by organising short courses in the Centre and by sending staff to national and overseas institutions for degrees or for specialised training. Besides receiving fellowships for study or training from number of agencies, the Centre received particular

support for the programme from Swiss Development Cooperation.

Staff development: in-house courses
During the year three courses were organised for 44 of the Centre's staff: one on the English language and two on computer software.

Staff development: national training:
During 1989, fifteen staff members were sent to institutions within the country for short courses of training in fields such as development planning and project management, community health, family planning, English language, budgeting and maintenance. In addition, one member of staff enrolled at the University of Dhaka as an external candidate for a doctoral degree in Nutrition.

Staff development: people
At the beginning of the year nineteen members of staff were currently studying overseas, in Australia, Belgium, France, Japan, the UK and the USA. During the year sixteen more left Bangladesh to begin courses or training while ten people returned.

Ms. Yasmin Ara Begum, a Research Officer, obtained an M.Phil. degree from the University of Dhaka and has since gone to Japan to study bacterial genetics at the Institute of Medical Sciences, University of Tokyo.

Dr. Abbas Bhuiya, Associate Scientist in DSS, gained a Ph.D. in Demography from the Australian National University. His dissertation is entitled "Factors Affecting Child Survival in Matlab, Bangladesh".

Mr. Golam Mostafa, a Data Management Officer with the DSS, was awarded a Masters degree in Medical Demography by the London School of Hygiene and Tropical Medicine.

Ms. Hosne Ara Begum, another Data Management Officer in the DSS, earned a Masters degree in Demography at the Australian National University.

Ms. Lutfun Nahar, a Senior Data Management Officer, received an IDRC award and left the Centre in September to begin studying for a Masters degree in Demography at the University of Western Ontario, Canada.

Dr.G.H. Rabbani, an Associate Scientist in the Clinical Sciences Division returned after three years training in the USA: two years at the State University of New York at Buffalo and one year at Yale University where he studied intestinal water and electrolyte transport. Dr. Rabbani was awarded an International Fellowship of the American College of Gastroenterology.

Dr. Anwar Syeed Udoy enrolled as a candidate for a Ph.D. at the London School of Hygiene and Tropical Medicine under the supervision of Dr. Andrew Tomkins.

Dr. A.K. Azad, a Senior Medical Officer in the CRC returned after spending more than two years at the State University of New York at Buffalo, USA, where he studied and conducted research on the digestion and absorption of rice-glucose polymer and the role of brush border glycoamylase.

Dr. Ruksana Haider, a Medical Officer in the CRC, left to begin her studies for a Master's degree in Human Nutrition at the London School of Hygiene and Tropical Medicine.

Dr. Shafiqul Alam Sarker, a Senior Medical Officer in the CRC, left to begin a one-year training course in Gastroenterology at the University Hospital, Basel, Switzerland.

Dr. M. A. Salam, Chief Physician of the CRC, visited the London School of Hygiene and Tropical Medicine to learn about measuring energy expenditure.

Dr. Abdullah-Hel Baqui, an Assistant Scientist in the Community Health Division, Dr. S K Roy, an Associate Scientist in Clinical Sciences Division and Dr. P K Bardhan, an Assistant Scientist in the same division, left the Centre to complete respectively the following degrees: a Doctorate in Public Health at The Johns Hopkins University, a Ph.D at the London School of Hygiene and Tropical Medicine and an M.D. at the University of Basel, Switzerland.

Mr. Ansaruzzaman, Section Chief of the Research Microbiology Section of the Laboratory Sciences Division, returned from Belgium where he had been undergoing training in clinical microbiology at the labo-

ratory of Prof.J.P.Butzler at the St. Pierre Hospital of the Free University of Brussels. He was joined by Dr. Mahbubur Rahman, an Assistant Scientist in the same division, who had also been trained in clinical microbiology in the same laboratory, left to begin a Ph.D in Microbiology.

Mr. Afsar Ali, a Research Officer in the Laboratory Sciences Division returned from the United States after six months training on Environmental Microbiology under the guidance of Prof. S.W. Joseph at the University of Maryland. After a few months he returned to the USA to begin research for a Ph.D. in the same laboratory.

Mr. S.M. Iqbal of the Bioengineering Cell, completed a one year post-graduate academic course in Computer Science at the Asian Institute of Technology in Bangkok.

Ms. Dilara Islam and Ms. Rubhana Raqib, both of whom were working in the Laboratory Sciences Division, left Dhaka to begin research for doctorates at the Karolinska Institute in Sweden. Most of their research, which is supported by SAREC, will be done in Bangladesh at the Centre.

Two staff of DISC received training abroad during the year: Mr. Farhad Hossain of DISC was sponsored by the British Council for a month's training in the UK on "Microcomputers for library and information work", while Mr. Mir Motasem Ali visited the Asian Institute of Technology in Thailand for three weeks training on computerised library services. ■

FINANCES AND DONORS

The ICDDR experienced a difficult year financially, but 1989 ended with a small deficit of only about US$ 33,000, before providing for depreciation of US$ 1,045,000. The Centre's income increased by 7% from US$ 11,015,000 to US$ 11,798,000, but expenditure increased also by 10% — from US$11,179,000 to US$ 12,336,000. The Centre's net current assets rose by US$ 130,000, due mainly to interest on the Reserve Fund.

The increase in expenditure during 1989 resulted primarily from the full impact of salary increases for local staff in July 1988 and January 1989 which ranged from 9% to 22%. Other expenditure decreased by 3% compared with 1988, a result of the completion of several large projects and the fact that there was no need for flood relief activities. The proportion of the Centre's total expenditure for salaries rose from 60% to 65% compared with 1988 (see Figure 4).

The Centre's cash position improved during 1989 and the year ended with no overdraft. This resulted from a reduction in the amount due from donors for work already completed and a reduction in advances and deposits paid by the Centre. Contributions received from donors to the work of the Centre over the past four years are shown in Table 6.

During the year a major review of the Centre's accounting system was carried out by consultants. As a result of this review several new accounting systems to improve financial management information are being developed to be put into operation in 1990.

External Relations

The Resources Development Office was reorganised during the year and renamed the External Relations Office, a title which now reflects its principal activity. An External Relations Officer is expected to be appointed in 1990. A committee under the chairmanship of the Centre's Finance Director was also established during the year to coordinate fund raising activities.

Australia, a regular donor to the Centre's core fund, continued its support in 1989 and

Figure 4
Expenditure for the last three years as a percentage of the total expenditure in US$.

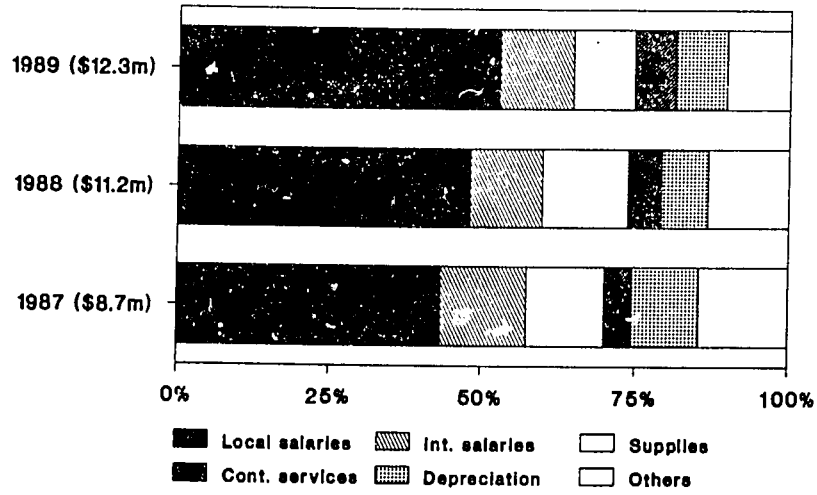


Table 6

Contributions to the ICDDR,B over the last five years on the basis of cash received in United States dolars (see Note 5 of the Auditors Report); < > indicates a refund.

	1989	1988	1987	1986	1985
Central Funds:					
Australia	191,845	216,893	126,325	123,237	143,365
Belgium	22,851	-	-	-	-
Bangladesh	37,288	38,071	-	59,311	-
Saudia Arabia	-	70,000	-	70,000	100,000
Sweden	-	-	-	117,810	-
Switzerland	709,212	792,931	-	780,309	310,813
UNICEF	250,000	250,000	250,000	500,000	250,000
United Kingdom	253,410	-	230,302	206,448	171,741
United States	300,000	275,000	250,000	500,000	-
Others	-	2,649	1,217	10,000	139
Sub-total	1,764,606	1,645,544	857,844	2,367,115	976,058
Project Funds:					
Aga Khan Foundation	<69,582>	155,983	45,585	17,951	52,260
Australia	46,188	-	-	-	-
Arab Gulf Fund	235,440	-	250,000	-	485,440
BAYER AG	122,000	-	-	-	-
Belgium	137,104	193,880	243,045	114,739	68,115
BOSTID	19,337	23,221	28,425	22,170	13,312
Canada - CIDA	1,153,661	599,143	953,979	1,021,677	807,806
Denmark - DANIDA	662,957	511,989	506,016	-	-
Ford Foundation	39,226	319,498	-	68,349	354,544
France	11,445	-	55,568	-	12,600
IDRC	68,082	-	53,884	93,796	85,468
IBRD	25,110	184,000	174,753	78,863	85,986
Japan	380,000	310,000	295,176	320,000	260,000
Miles Pharmaceuticals	-	-	107,822	47,399	-
Netherlands	37,817	50,000	-	-	-
Norway - NORAD	395,913	308,291	459,364	427,827	228,837
Norwich Eaton Pharmaceuticals	-	-	12,086	22,500	10,500
Population Council	-	-	13,438	5,352	32,474
Saudi Arabia	406,333	-	530,708	536,596	275,053
Switzerland - SDC	446,696	-	136,920	-	-
UNDP/UNROB	-	-	-	43,571	43,570
UNDP - UVP	-	-	-	103,154	96,470
UNDP/WHO	300,000	-	300,000	388,000	187,000
UNICEF	6,000	57,580	193,665	335,480	253,645
United States - AID	4,653,206	3,786,737	3,189,544	3,167,627	2,980,682
WHO	175,814	201,563	195,040	88,104	57,762
Wellcome Trust	17,228	28,658	29,019	-	-
WUSC/CIDA	689,662	571,879	-	-	-
Flood Relief Funds	374,474	464,494	-	-	-
Others	45,256	26,027	63,589	132,698	119,815
Sub-total	10,359,367	7,792,943	7,8[illegible]7,626	7,035,853	6,511,339
Capital Funds: UNCDF	272,159	526,420	-	-	-
GRAND TOTAL US$	12,396,132	9,964,907	8,695,470	9,402,968	7,487,397

provided additional funds for research projects and for training in electron microscopy.

The Government of the People's Republic of Bangladesh, remained a generous supporter of the Centre and has continued to provide central funds as well as material assistance in support of the Centre's activities.

The Belgian Administration for Development Co-operation (BADC) remained an active supporter of the Centre's core, project and training activities. A new five-year agreement was signed in 1989 under which Belgium will increase its annual grant to the Centre and provide technical staff.

The Canadian International Development Agency (CIDA) extended its financial support for the Centre's Demographic Surveillance System through 1989.

The Danish International Development Agency (DANIDA) grant to the Clinical Research Centre ended in December 1989, but DANIDA agreed during the year to continue supporting the Child Health Programme in 1990. Support to other Clinical Research Centre activities will be finalised after a review.

The Ford Foundation, France, the Wellcome Trust and the International Development Research Centre (Canada) all provided funding for project activities in 1989.

Japan continues to be an important donor to the Centre. In 1989 it provided increased financial support to clinical research, laboratory and training activities.

The Government of the Netherlands continued their support to the Acute Respiratory Tract Infection Project in Matlab in 1989.

NORAD, the Norwegian agency for development, which began it's support of the MCH/FP services in Matlab 1985 has agreed to continue their support throughout 1990.

The current phase of support for core and project activities by Swiss Development Co-operation (SDC) ended in 1989. However the SDC continues to be a keen and significant supporter of the Centre and negotiations for new funding are underway.

SAREC, the Swedish aid agency, renewed making contributions to the Centre starting in 1989 for a two-year period.

The construction of a Diarrhoea Treatment Centre in Matlab progressed satisfactorily in 1989 and it is expected to be completed in early 1990. This project is being undertaken with the financial assistance from the United Nations Capital Development Fund.

The United Nations Development Programme maintained it's support for clinical research at the Centre in 1989 while UNICEF continued to support core activities and specific projects.

The United States Agency for International Development (USAID) continues to be a major donor to the Centre, funding both core and project activities. The Co-operative Agreement with USAID in Washington ended in December 1989 and a one year extension was approved for 1990 to allow the next agreement to be finalised. The USAID Mission in Dhaka continued it's support for the Centre's Urban Volunteer Programme and the MCH/FP Extension Project throughout 1989.

World University Service of Canada (WUSC) continued its grants grant to support the Matlab MCH/FP Programme, the Matlab Treatment Centre and to provide technical assistance in the form of consultants and staff on secondment.

The World Health Organisation continued to remain an important source of research funds for the Centre and several research projects were financed.

The ICDDR has successfully completed a collaborative project on ORS in Kenya with the support of the Aga Khan Foundation. The collaborative activities in China, also funded by the Foundation, ended during the year by mutual agreement.

Donors' Support Group

The ICDDR organised meetings of the Donors' Support Group in Dhaka in June and in Geneva in December. At the meeting in Geneva the Centre's Strategic Plan for the next five years was presented to donors and discussed. ■

COMMITTEES

The ordinance of the Centre states that it should have a **Board of Trustees** to provide general direction to the affairs of the Centre. The Board has seventeen members: the Director of the Centre plus three people nominated by the Government of Bangladesh, one nominated by the World Health Organization, one nominated by the United Nations and eleven members at large, of whom at least a half must come from developing countries. Each June one third of the members complete their three-year term unless re-elected for another term, after which they must retire.

The Board of Trustees meet twice a year, usually in Dhaka, and consider matters of science, finance and personnel. The Director of the Centre is Secretary to the Board. The members of the Board until 30th June were:

Prof. Derrick Rowley - Australia (Chairman)
Prof. Roger Eeckels - Belgium (Secretary)
Dr. A.R. Al-Swellem - Saudi Arabia
Mr. M.K. Anwar - Bangladesh
Dr. Deanna Ashley - Jamaica
Dr. Immita Cornaz - Switzerland
Prof. Richard Feachem - UK
Prof. Demissie Habte - Ethiopia
Prof. D.A. Henderson - USA
Prof. A.A. Lindberg - Sweden
Prof. V.I. Mathan - India
Dr. M.H. Merson - Representative of WHO
Prof. K.A. Monsur - Bangladesh
Mr. Taslimur Rahman - Bangladesh
Prof. V. Ramalingaswami - UNICEF
Dr. P. Sumbung - Indonesia
Prof. H. Tanaka - Japan

On 1st July the following changes were made leaving one position vacant.

Dr. Peter Sumbung - Indonesia (Chairman)
Dr. Demissie Habte - (Director and Secretary from August 1989)
Dr. Y.Y. Al-Mazrou - Saudi Arabia (replaced Dr. A.R. Al-Swellem)
Prof. J.C. Caldwell - Australia (replaced Prof. D. Rowley)
Prof. J.R. Hamilton - Canada (replaced Dr. I. Cornaz)

The Programme Coordination Committee (PCC) is a mandatory committee which coordinates research with the work of national institutes in Bangladesh. Its objectives are:

- to ensure that the Centre offers fellowships and facilities for training and research to Bangladeshi scientists and health personnel
- to ensure that the Centre establishes and maintains contact with Bangladeshi institutes by means of collaborative research, seminars, and exchange of visits
- to ensure that the Centre avoids actions prejudicial to the interest of research in similar fields carried out by other organisations in Bangladesh
- to assist in solving any controversy in relation to the involvement of the ICDDR in research and training.

Until it was reconstituted in December 1989, the PCC had 45 members: five from the ICDDR and the remainder from Government departments, universities and nongovernmental organisations concerned with science, health, development, education and population studies. The new committee will be in office until December 1992. The Chairman is Prof. M.A. Matin, the Vice Chairman is Prof. Kamaluddin Ahmad and the Member-Secretary is Prof. Demissie Habte. The members of the reconstituted PCC are:

Prof. M.A. Matin
Prof. Kamaluddin Ahmad
Prof. Demissie Habte, Director, ICDDR
Prof. Nurul Islam
Maj. Gen. M.R. Chowdhury
Prof. K.A. Monsur
Prof. T.A. Choudhury
Dr. Humayun K.M.A. Hye
Brig.(Retd) M. Hedayetullah

Dr. Zafrullah Choudhury
Dr. A.K. Khan
Dr. Mobarak Hossain
Dr. Sultana Khanam
Dr. Deanna Ashley (Board of Trustees of the ICDDR)
Prof. J.R. Hamilton (Board of Trustees of the ICDDR)
Prof. D.A. Henderson (Board of Trustees of the ICDDR)
Vice - Chancellor, Bangladesh Agricultural University, Mymensingh
Vice - Chancellor, Dhaka University
Vice - Chancellor, Bangladesh University of Engineering and Technology, Dhaka
Vice - Chancellor, Chittagong University
Vice - Chancellor, Jahangir Nagar University, Savar, Dhaka
Vice - Chancellor, Islamic University, Kushtia
Vice - Chancellor, Shah Jalal University of Science and Technology, Sylhet
Vice - Chancellor, Khulna University
Chairman, Bangladesh Agricultural Research Council, Dhaka
Chairman, BCSIR Laboratories, Dhaka
Director General, Health Services, Government of Bangladesh
Director General, Family Planning, Government of Bangladesh
Director General, NIPORT, Dhaka
Research Director, Bangladesh Institute of Development Studies
Medical Director, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders, Dhaka
Director, Institute of Post - Graduate Medicine and Research, Dhaka
Director, Institute of Nutrition and Food Science, Dhaka University
Director, Institute of Public Health, Dhaka, Director, National Institute of Preventive and Social Medicine, Dhaka
Director, Institute of Public Health Nutrition, Dhaka
Director, Bangladesh Fertility Research Programme, Dhaka
Director Programmes, Bangladesh Rural Advancement Committee Dhaka,
Director, MIS Unit, Directorate of Family Planning, Government of Bangladesh
Joint Director, Dhaka Shishu Hospital
Director, Institute of Bangladesh Studies, Rajshahi University
Director, Bangladesh Medical Research Council, Dhaka
Project Director, CDD Programme, Office of Director General of Health Services, Dhaka,
Director, Cancer Institute and Research Hospital
Director, Institute of Herbal Medicine, C/O BCSIR Laboratories, Dhaka
Associate Director, Clinical Sciences Division, ICDDR
Associate Director, Laboratory Sciences Division, ICDDR
Director, Community Health Division, ICDDR
Director, Population Science and Extension Division, ICDDR

The Research Review Commitee (RRC) assess research proposals in terms of their scientific value, significance and feasibility in the light of the Centre's objectives and financial resources. The Committee was reconstituted in 1989 and the procedure for reviewing proposals was made more effective, notably by including a process of external review by at least two international experts. This RRC is composed of scientists and physicians from the ICDDR and representaives from the PCC Standing Committee. During 1989 the RRC met five times and considered 14 proposals: 11 were approved, two were noted as being concerned with the establishment of new laboratories and the consideration of one proposal was deferred. The members of RRC in 1989 were:

Professor Roger Eeckels, Chairman to 14th July 1989.
Professor Demissie Habte, Chairman from 20th August 1989.
Dr. Dilip Mahalanabis, Acting Chairman from 15th July 1989 to 19.8.89.
Prof. Kamaluddin Ahmad
Maj.Gen. M.R. Choudhury
Dr. Saul Tzipori
Dr. André Briend, until 30th June 1989,

The Committee was expanded in December by the addition of three scientists:

Dr. Michael Strong (PSED)
Dr. John Albert (LSD)
Dr. P.K. Bardhan (CHD)

After research proposals have been by the RRC the Ethical Review Committee (ERC) meets to examine ethical issues involved in research on humans subjects. It has 15

members: four from the Centre, one each from the PCC Standing Committee, the Bangladesh Medical Research Council, and from the WHO in Bangladesh, and eight people representing other disciplines.

The ERC has a subcommittee which occasionally inspects research projects on behalf of the Committee to ensure that they are being conducted ethically and according to the approved proposal. The Committee helps to ensure that patients know about the quality of medical care, that they will not be affected if they wish to withdraw from a study, and that their privacy is not infringed.

In 1989 the ERC met 11 times and considered 22 research proposals including three PCC-collaborative studies. Eighteen proposals were approved, two were not approved and decisions were deferred for two others. In 1989 the members of the ERC were:

Prof. Kamaluddin Ahmad, Chairman and representative of the PCC Standing Committee; Biochemist and Nutritionist.
Dr. Humayun K.M.A. Hye, Alternative Chairman; Pharmacologist
Prof. T.A. Choudhury, 2nd Alternative Chairman and representative of the Bangladesh Medical Research Council; Gynaecologist
Prof. K.A. Monsur, Scientist
Dr. Shafiqur Rahman; Community Scientist
Barrister K.Z. Alam, Lawyer
Mrs. Taherunnessa Abdullah; Behavioural Scientist
Mrs. Husnara Kamal, Behavioural Scientist
Mr. Md. Mofazzal Hossain Khan; religious representative
Dr. Jamal Ara Rahman; non-scientific member
Dr. R.S. Giri, representative of WHO, Dhaka
Dr. D. Mahalanabis, Associate Director, Clinical Science Division, ICDDR; Clinician
Dr. André Briend, Associate Director, Community Health Division, ICDDR; Nutritionist (to 30th June 1989)
Dr. K.M.A. Aziz, Scientist, ICDDR; Anthropologist (from 12th September 1989)
Dr. A.N. Alam, Clinical Research Centre, ICDDR; Clinician
Mrs. Rahima Khatun, Nursing Manager, Dhaka Hospital, ICDDR

The Council of Associate Directors is a consultative management body comprising the Associate Directors of Divisions or Acting heads. They meet each week to advise and assist the Director in running the Centre. The members of the Council in 1989 were:

Dr. Roger Eeckels, Director - to July
Prof. Demissie Habte, Director - from August
Dr. K.M.A. Aziz (CHD) - from September to December
Mr. M.R. Bashir (Resources Development) - to July
Dr. André Briend (CHD) - to July
Mrs. Judith Chowdhury, Minute Secretary
Dr. Michael Koenig (PSED) - from September
Dr. Dilip Mahalanabis (CSD)
Mr. M.A. Mahbub (Administration and Personnel)
Dr. A.K.M. Siddique (CHD) - from December
Dr. Michael Strong (PSED) - from September
Dr. Saul Tzipori (LSD)
Mr. John Winkelmann (Finance)

The Consultative Management Committee includes members of the Council of Associate Directors, other senior members of the Centre's administration, representatives of each division, and the President of the Staff Welfare Association (SWA). It meets four to six times a year as an informal platform for a wider discussion of the management of the ICDDR,B. During 1989 its members in addition to those the Council of Associate Directors were:

Mr. W. Ahmed (Personnel Branch)
Dr. R.L. Akbar (Training Branch)
Dr. J. Albert (LSD)
Mr. M.A.B. Bhuiyan (SWA)
Dr. Aminul Islam (CSD)
Dr. M.M. Islam (LSD)
Dr. I. Kabir (CSD)
Mr. M.R. Khalili (Finance Office)
Mr. M.S.I. Khan (DISC)
Mr. T.A. Khan (Maintenance Branch)
Dr. R. Maru (PSED)
Mr. M.G. Morshed (Supply Branch)
Mr. M.A.K. Shaikh (PSED)
Dr. Diana Silimperi (CHD)
Mrs. A. Stephen (CSD)
Mr. M.A. Wahed (LSD)
Dr. Md. Yunus (CHD) ■

PEOPLE

At the end of 1989 the Centre had 1,294 members of staff plus 154 Community Health Workers and 234 Volunteers. There were 37 international level staff, 18 of whom were on secondment, 184 staff of National Officer grade and 1,073 of the General Service Grade.

Departures

In addition to the departure of the Director, Dr. Roger Eeckels (see below), two Associate Directors left during the year. Dr André Briend (France), who had been on secondment to the Centre since 1984 from the *Institut Français de Recherche Scientifique pour le Développement en Coopération* (still called "ORSTOM"), resigned in June and is now working at the headquarters of ORSTOM in Montpellier, France. Mr. M.R. Bashir (Bangladesh), the Associate Director of the Resources Development Division since the establishment of the ICDDR, left in June 1989 after eleven years at the Centre.

Asem Ansari

Professor Roger Eeckels

Roger Eeckels joined the Centre in 1985 on secondment from the University of Leuven in Belgium where he was Professor and Head of the Department of Paediatrics. Born in Antwerp, he studied medicine in Ghent before returning to Antwerp to take a Diploma at the Institute of Tropical Medicine. In 1960 he left Belgium to work for eight years in Zaire. During that time his observations on the association between certain haemoglobin genotypes and severe bacterial infections in children were reported in *Nature*.

When Roger Eeckels arrived at the ICDDR a serious financial crisis was rapidly approaching. Severe cuts and strict financial management revived the Centre over the next three years but not without the need for him to take large administrative burdens and weighty responsibilities. It must sometimes have been frustrating to have to sit behind piles of paper rather than be with working with young physicians in the paediatric wards, or discussing scientific data with colleagues.

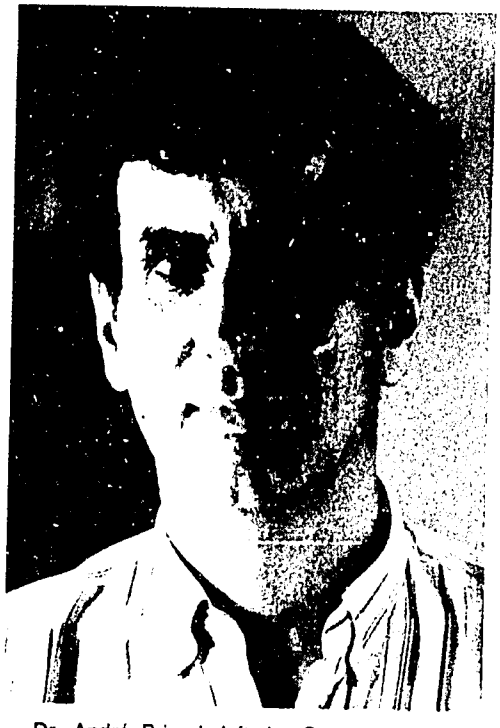
Although the phrase is now somewhat old fashioned, Roger Eeckels was a scholar and a gentleman. He had an appreciation for the subtleties of language and as well as speaking Flemish he spoke fluent English and French as well as good German and some Russian. He was a painstaking editor and helped many young scientists get their publications into shape. He also had an ability to see the best in people and to encourage their talents.

Roger Eeckels made many friends during the time he was Director, friends who were distressed at his abrupt departure. But his unselfish dedication to the ICDDR was manifest even at that time, and although he must have been disappointed to leave Dhaka and return to Leuven, his hard work during four critical years has given momentum to the to the Centre's struggle to survive. (A.H.) ■

Dr. Shanti Kasatiya (Canada), the Head of the Laboratory Services Department, left in May 1989 after completing his one-year assignment.

Mr. Hira M. Ashraf (Pakistan), the Systems Development Manager for the Demographic Surveillance System, left the Centre to work in Canada after completing four years of service.

Dr. Fitzroy Henry (Guyana), an International Research Associate in the Community Health Division, completed six years at the Centre in December 1989. He has now joined the diarrhoeal diseases programme at the Harvard Institute for International Development in Cambridge, Massachusetts.



Asim Ansari

Dr. André Briend: left the Centre in 1989

Three Belgians provided on secondment by the BADC left during the year: Mr. Albert Felsenstein, a Biologist, left the Centre in October 1989 to return home; Dr. Carine Lenders a Physician working with the UVP, left in May to go work in the USA; and Dr. Carine Ronsmans a Physician in the Community Health Division, left in August to begin studies for an M.P.H. at the Harvard School of Public Health in the USA

Mr. Anil Pabani (Canada), the Centre's Grants Administrator provided on secondment from WUSC, left in August 1989. Dr. Gary Hlady (USA), an International Research Associate in the Community Health Division on secondment from the Johns Hopkins University, returned to the USA Dr. Hlady has since returned to Bangladesh to be the local representative of Global 2000.

A Research Fellow with the MCH/FP Extension sponsored by United States AID, Mr. Thomas McElrath (USA), left at the beginning of 1989 after spending a year at the Centre.

Dr. Jeffery K. Griffiths (USA), a Research Fellow seconded by Tufts University, left in August 1989 to return to a clinical post at the New England Medical Centre in Boston.

Two American physicians seconded by the Johns Hopkins University, Dr. O. Massie Bateman and Dr. Richard Besser spent some of the year with the Urban Volunteer Project trying to set up research studies.

Dr. Poul-Erik Kofoed (Denmark), the Head of the Child Health Programme, left in November 1989.

New staff

Dr. Demissie Habte (Ethiopia) took over as interim Director of the Centre in August 1989 on the resignation of Dr. Eeckels, and was then appointed Director by the Board of Trustees at their meeting in December. Dr. Habte received his undergraduate medical education at the American University of Beirut and did his paediatic residency at the New York Hospital, Cornell Medical Centre in New York, USA He joined the Faculty of Medicine at Addis Abbaba University in 1970 and was appointed Professor of Paediatrics in 1980. In 1983 he became Dean of the Faculty of Medicine and in 1986 joined the Board of Trustees of the ICDDR.

Three Bangladeshi scientists, Dr. Tasnim Azim, Dr. S.M. Faruque and Dr. Rashidul Haque, joined the Laboratory Sciences Division during the year. Dr. Azim, a Physician, recently completed her Ph.D. in Immunology

at University College, London, UK, and will be setting up a Cellular Immunology Laboratory. Dr. Faruque joined the Centre from the Department of Biochemistry at the University of Dhaka to establish a Molecular Biology Laboratory. Dr. Haque, who trained in medicine at the Sofia Medical Academy in Bulgaria and then gained a Ph.D. in Parasitology from the Bulgarian Academy of Sciences, will be working to set up a Parasitology Laboratory.

Asem Ansari

Mr. M.R. Bashir: left the Centre in 1989

Two Australians also joined the Laboratory Sciences Division to help establish new laboratories: Ms Leanne Unicomb, a Virologist from the Royal Children's Hospital in Melbourne and Dr. John Albert, a Research Microbiologist formerly with the Menzies School of Health Research in Darwin and the Alice Springs Hospital.

Two staff who joined the Population Science and Extension Division during 1989 are Dr. Radheshyam Bairagi (Bangladesh), as a Senior Scientist, and Dr. Maxine Whittaker (Australia) as an Operations Research Scientist with the MCH/FP Extension Project.

DANIDA provided Ms. Birgitte Brunn Nielsen and Mr. Thomas Schioler as Associate International Research Fellows for the Child Health Progamme. Dr. Sushila Zeitlyn of the Department of Social Anthropology at the London School of Economics also joined the CHP as a consultant.

The World University Service of Canada (WUSC) provided two new Canadian members of staff: Ms. Michelle Munro as a Nurse/Health Educator and Ms. Churamoni Jagdeo as a Nurse/Health Trainer.

Dr. Rushikesh Maru (India) of the University of Michigan joined the Centre as an Operations Research Scientist in the MCH/FP Extension Project, PSED. To the same project the Population Council provided Dr. Uhaidur Rob (Bangladesh) as a Post-Doctoral Fellow.

Ms. Nancy Stark (USA) a doctoral student in anthropology from the Southern Methodist University, joined the Centre in March on a Fulbright Fellowship to undertake field work in Matlab for a dissertation on reproductive decision making and obstetrical care.

Obituaries

It is sad to record the death of three long serving members of staff during the year: Mr. Eugene D'Cruze (12 years), Mr. Hafizur Rahman (22 years) and Mr. Abdus Samad (25 years).

Retirements

Six members of staff retired from the Centre during the year: Mr. Abdus Sattar, Infection Control Officer; Mrs. Suratonnessa, Nursing Officer; Mr. Ismail Khan, Pharmacy Assistant; Mr. Paul Dass, Administrative Assistant; Mr. Ershadullah Mojumder, Ward Master; and Mr. Minnat Ali, Security Guard.

Long service

Forty-nine members of staff completed 25 years of service to the Centre and its predecesor during the year and were awarded a meritorious increase in pay. They are: Mr. Azizur Rahman, Pharmacy Assistant; Mrs. Lutfun Nahar, Assistant Staff Nurse; Mrs. Rumi Gomes, Aid Nurse; Mrs. Ful Rani Biswas, Aid

Nurse; Mr. Asit Baran Saha, Aid Nurse; Mrs. Shishu Bala Mali, Cleaner; Mr. Amir Ali Khan, Ward Attendant; Mr. Dilu Mia, Cleaner; Mr. Md. Muzibur Rahman, Senior Research Officer; Mr. Md. Ghyasuddin, Research Officer; Mr. Md. Omar Ali Miah, Laboratory Technician; Mr. Shahjahan Mian, Laboratory Technician; Mr. Sayed Rezaul Karim, Laboratory Technician; Mr. Abdul Ghani, Laboratory Technician; Mr. Manik Miah, Animal Technician; Mr. Abul Hasan, Senior Laboratory Attendant; Mr. Abdus Sobhan Bepary, Senior Laboratory Attendant; Mr. Matiur Rahman Khan, Manager, Special Studies; Mr. Mohammad Mokbul Hossain, Field Research Officer; Mr. Dinesh Chandra Saha, Senior Health Assistant; Mr. Md. Abdul Baten, Senior Health Assistant; Mr. Sukha Ranjan Paul, Senior Health Assistant; Mr. Abu Taher, Senior Health Assistant; Mr. Chitta Ranjan Das, Senior Health Assistant; Mr. Kh Shamsuddin Ahmed, Foreman, Marine Equipment; Mr. S.M. Abdul Aziz, Administrative Assistant; Mr. Sekander Hayet, Administrative Assistant; Mr. Joynal Abedin, Mechanic; Mr. Mohd. Ashequr Rahman, Health Assistant; Mr. Siddiqur Rahman Patwary, Health Assistant; Ms. Dominica Purification, Health Assistant; Mr. Md. A. Mazid Sardar, Manager, DSS; Mr. AKM Nurul Islam, Senior Field Research Officer; Mr. Mukhlesur Rahman, Field Research Officer; Mr. Md. Ismail, Field Research Officer; Mr. A.K.M. Mozibul Hoque, Administrative Assistant; Mr. Md. Nasiruddin, Senior Health Assistant; Mr. Khalilur Rahman, Assistant Supervisor; Mr. Mohd. Zahirul Hoque, Health Assistant; Mr. Mohd. Nurul Hoque, Health Assistant; Mr. Md. Idris Ali Miah, Health Assistant; Mr. Mohd. Idris Miah, Health Assistant; Mr. Golam Hossain, Health Assistant; Mr. Md. Abdul Jabbar, Personnel Manager; Mr. SM Abdus Sattar, Senior Store Officer; Mr. Abdul Halim Bhuiyan, Administrative Assistant; Mr. Tofazzal Hossain, Foreman, Vehicle Maintenance; Mr. Chitta Ranjan Das, Security Guard; and last but not least Mr. Abdur Rahman, Security Guard.

Vistors and Consultants

There were several consultants from the London School of Hygiene and Tropical Medicine during the year. Dr.John Ackers came in June to help review the work of the Laboratory Sciences Division, Ms. Betty Kirkwood was a reviewer of the Community Health Division, Dr. Andrew Tomkins visited collaborative projects, and Mr. Simon Cousens was a WHO consultant providing technical assistance to WHO supported projects.

The other reviewer of the Laboratory Sciences Division in March was Dr. Roger Glass from the Centers for Disease Control in Atlanta, USA The other reviewers of the Community Health Division in June were Dr. Shanti Ghosh from India and Dr. Halida Haunum Akhtar, the Director of the Bangladesh Fertility Research Programme. In August Dr. Jane Mencken of the Univserity of Pensylvania undertook a one-woman review of the Population Science and Extension Division.

The Dutch Ambassador, H.E. Mr. J.H.J. Jeurissen, accompanied a delegation from the Netherlands Parliamentary Committee on Development Cooperation to Matlab in February. The group included Mrs. E.L. Herfkens, Mrs. M.B.C. Beckers-de Bruijn, Mr. G. van Leijenhorst, Mrs. M.J.J. Roosen-van Pelt, Mrs. E.G. Terpstra, Mrs. J.M. Verspaget and Mr. J.N. van Overbeeke.

Another diplomat to travel to Matlab was H.E. Mr. Carl Olof Cederblad, the Ambassador of Sweden in Bangladesh while the Japanese Ambassador, H.E. Mr. Takeo Iguchi visited the Centre in Dhaka.

In September, Dr. Azizur Rahman, Minister, and Mr. S. Hasan Ahmad, Secretary, of the Ministry of Health and Family Planning, inaugurated a training course in Matlab.

Dr. Tatiana Romanova from the Soviet Union worked as a consultant on a project detecting the metabolites of *Ascaris lumbicoides* in the urine of infected people.

Another vistor from the Centers for Disease Control in Atlanta, USA, during 1989 was Dr. Boris Lushniak of the Epidemic Intelligence Service who worked with the UVP to develop their slum surveillance system (see page 22).

Dr. Richard Cash of the Applied Diarrhoeal Disease Research unit of the Harvard Institute for International Development in the USA visited the Centre in September with 22 health professionals from Africa, Asia and America.

Dr. José Martines, a Medical Officer with the Diarrhoeal Diseases Control Programme at

the WHO, visited the Centre to evaluate a project in November.

Nearly 250 people visited Matlab during the year including: Dr. John Evans and Dr. Lincoln Chen of the Commissions on Health Research For Development; Mr. Charles Bailey, the Ford Foundation Representative in Dhaka; Dr. Rita Collwell the Director of the Biotechnology Institute of the University of Maryland, USA, and Dr. John Rohde of UNICEF in New Delhi.

Mr. Bjarne Soerensen, Head of the Asia Division of DANIDA, and Ms. Susanne Esbjoern, Head of the Bangladesh Section of DANIDA in Copenhagen visited the Centre in December for discussions on future cooperation.

Dr. Sam Joseph, a regular visitor to the ICDDR from the Department of Microbiology, University of Maryland, USA, conducted a workshop on *Aeromonas*. ■

ICDDR,B PUBLICATIONS 1989

A INTERNAL PUBLICATION SERIES

A1 ICDDR,B Annual Report, 1988. Andrew Hall, ed. July 1989. 77 p.

Specialized Bibliography Series

A2 Annotated bibliography on diarrhoeal diseases: review articles and selective studies, compiled by M Shamsul Islam Khan, Malik M Abdul Quader, M Motasem Ali and M M Hassan. Abstractors: Iftekharul Islam and Mahua Khair. Editors: Arifuzzaman Khan and Nishat Chowdhury. Editor-in-Chief: Roger Eeckels. 1989. i, 316 p. (Specialized bibliography series no. 13)

Journal and Newsletter

A3 Journal of Diarrhoeal Diseases Research (also includes: Bibliography on Diarrhoeal Diseases). v.6, nos.2-4, 1988 and v. 7, nos. 1&2, 1989.

A4 Glimpse. v. 11, nos. 1-4, 1989.

B ORIGINAL SCIENTIFIC PAPERS (Including Short Communications):

B1 Akhter SQ. Antimicrobial sensitivity and plasmid-mediated tetracycline resistance in *Campylobacter jejuni* isolated in Bangladesh. *Chemotherapy* 1988;34(4): 326-31*

B2 Akhter SQ, Huq F. Effect of *Campylobacter jejuni* extracts and culture supernatants on cell culture. *J Trop Med Hyg* 1989 Apr;92(2):80-5

B3 Alam N, Wojtyniak B, Rahaman MM. Anthropometric indicators and risk of death. *Am J Clin Nutr* 1989 May;49(5):884-8

B4 Alam N, Wojtyniak B, Henry FJ, Rahaman MM. Mothers' personal and domestic hygiene and diarrhoea incidence in young children in rural Bangladesh. *Int J Epidemiol* 1989 Mar;18(1):242-7

B5 Alam N, Henry FJ, Rahaman MM. Reporting errors in one-week diarrhoea recall surveys: experience from a prospective study in rural Bangladesh. *Int J Epidemiol* 1989 Sep;18(3):697-700

B6 Baqui AH, Zaman K, Yunus M, Mitra AK, Hossain KMB, Banu H. Epidemiological and clinical characteristics of shigellosis in rural Bangladesh. *J Diarrhoeal Dis Res* 1988 Mar;6(1):21-8*

B7 Bari A, Rahman ASMM, Molla AM, Greenough WB, III. Rice-based oral rehydration solution shown to be better than glucose-ORS as treatment of non-dysenteric diarrhoea in children in rural Bangladesh. *J Diarrhoeal Dis Res* 1989 Mar&Jun;7(1&2):1-7

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APPENDIX A

AUDITORS' REPORT
TO THE BOARD OF TRUSTEES OF
INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH

We have examined the Balance Sheet of International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) as of December 31, 1989 and the related statement of Income and Expenditure (Operating Fund) for the year then ended which are in agreement with the books of account maintained by the Centre and produced to us. Our examination was made in accordance with generally accepted auditing standards and, accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion and to the best of our information and according to the explanations given to us, the Balance Sheet and the Statement of Income and Expenditure together with the notes attached thereto, present respectively a true and fair view of the state of affairs of the Centre as at December 31, 1989 and the results of its operations for the year then ended.

HODA VASI CHOWDHURY & CO.
Chartered Accountants

DELOITTE HASKINS & SELLS
Chartered Accountants

Dhaka, March 29, 1990

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH
BALANCE SHEET AS AT DECEMBER 31, 1989

	Notes	1989	1988
FIXED ASSETS: Cost less accumulated depreciation	(3)	4,067,149	3,941,476
CURRENT ASSETS:			
Stock of stores and spares	(4)	472,415	480,597
Contributions receivable from donors	(5)	906,872	1,605,302
Advances, deposits and prepayments	(6)	436,890	1,052,006
Deposits with Bank against Reserve Fund	(7)	1,819,073	1,669,726
Cash and bank balances	(8)	966,022	792,092
		4,601,272	5,599,723
LESS: CURRENT LIABILITIES:			
Bank overdraft	(9)	–	1,255,496
Interest free loan	(10)	1,186,080	1,186,080
Contributions paid in advance by donor	(5)	1,063,897	1,436,109
Other current liabilities & Provisions	(11)	1,623,026	1,123,731
		3,873,003	5,001,416
NET CURRENT ASSETS		728,269	598,307
	US$	4,795,418	4,539,783
FINANCED BY:			
Capital Development Fund	(12)	8,411,651	7,227,182
Operating Fund	(13)	(5,435,306)	(4,357,125)
Reserve Fund	(14)	1,819,073	1,669,726
	US$	4,795,418	4,539,783

THE ATTACHED NOTES CONSTITUTE AN INTEGRAL PART OF THESE ACCOUNTS

Director
ICDDR,B

Member
Board of Trustees

This is the Balance Sheet referred to in our report of same date.

HODA VASI CHOWDHURY & CO.
Chartered Accountants

DELOITTE HASKINS & SELLS
Chartered Accountants

Dhaka, March 29, 1990

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH

STATEMENT OF INCOME AND EXPENDITURE (OPERATING FUND) FOR THE YEAR ENDED DECEMBER 31, 1989

	NOTES	1989	1988
INCOME			
Contributions	(5)	11,797,755	11,015,367
LESS:			
Transferred to Capital Development Fund to the extent of capital expenditure	(12)	912,310	629,690
		10,885,445	10,385,677
ADD:			
Exchange gains		53,807	61,294
Other receipts	(17)	318,829	435,146
		11,258,081	10,882,117
EXPENDITURE			
Personnel salaries & benefits - local		6,501,523	5,362,859
Personnel salaries & benefits - international		1,480,027	1,319,442
Consultancy - Local & International		237,000	377,898
Mandatory Committee Meetings		128,428	75,371
Travel		350,272	468,148
Supplies and materials		1,226,072	1,569,688
Repairs and maintenance		89,984	100,406
Rent,communication & public utilities		322,984	288,837
Printing and publications		157,397	166,219
Other contractual services		797,287	588,015
Depreciation	(3)	1,045,288	862,159
		12,336,262	11,179,042
DEFICIT OF INCOME OVER EXPENDITURE	US$	(1,078,181)	(296,925)

THE ATTACHED NOTES CONSTITUTE AN INTEGRAL PART OF THESE ACCOUNTS

Director
ICDDR,B

Member
Board of Trustees

This is the Statement of Income and Expenditure referred to in our report of same date.

HODA VASI CHOWDHURY & CO.
Chartered Accountants

DELOITTE HASKINS & SELLS
Chartered Accountants

Dhaka, March 29, 1990

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH

STATEMENT OF SOURCES AND APPLICATIONS OF FUNDS FOR THE YEAR ENDED DECEMBER 31, 1989

		1989	1988
SOURCES			
* Net Operating (Deficit)/Surplus		(30,840)	565,428
Increase in Capital Fund			
- Donors' Contribution utilised for capital expenditure		912,310	629,690
- UNCDF Restricted fund for construction of hospital at Matlab - Cash		258,266	526,420
- In kind		13,893	-
		1,184,469	1,156,110
Increase in Reserve Fund			
- Interest received on time deposits		71,663	66,587
- Interest accrued on time deposits		77,684	50,219
		149,347	116,806
Sale proceeds of fixed assets		1,837	3,178
	US$	1,304,813	1,841,522
APPLICATIONS			
Additions to fixed assets		831,954	629,690
Increase in capital work-in progress		342,897	462,383
Increase in net current assets		129,962	749,449
	US$	1,304,813	1,841,522

* CALCULATION OF NET OPERATING (DEFICIT)/SURPLUS

Deficit as per the Statement of Income and Expenditure (Operating Fund)		(1,078,181)	(296,925)
Add - Depreciation charge for the year		1,045,288	862,159
- Loss on sale of fixed assets		2,053	194
	US$	(30,840)	565,428

INTERNATIONAL CENTRE FOR DIARRHOEAL DISEASE RESEARCH, BANGLADESH

NOTES TO THE ACCOUNTS FOR THE YEAR ENDED DECEMBER 31, 1989

1. NATURE OF ACTIVITIES

The International Centre for Diarrhoeal Disease Research, Bangladesh (here-in-after referred to as the "Centre") was established in 1978 by an Ordinance of the Government of The People's Republic of Bangladesh to provide for the establishment of an international centre in Bangladesh with multinational scientific collaboration and financial contribution to conduct research in diarrhoeal diseases and directly related subjects of nutrition and fertility with special relevance to developing countries and for matters ancilliary thereto. The activities of the centre are mainly funded by various Governments and International organisations.

2. SIGNIFICANT ACCOUNTING POLICIES

i) These accounts have been prepared on a going concern basis and in accordance with generally accepted accounting principles on historical cost convention.

ii) The Statement of Income and Expenditure and the Balance Sheet of the centre are prepared in the manner as prescribed and approved by the Board of Trustees.

iii) "Income and "Expenditure" of the Centre for the year have been accounted for on an accrual basis except other receipts which are accounted for on cash receipt basis inconformity with the past practice.

iv) Contributions have been considered as income on the following bases.

(a) Core Funds have been accrued to the extent they relate to current period and those pertaining to future period have been carried forward.

(b) Project Funds received during the year but not expended have been carried forward as contributions received in advance. Correspondingly, amounts equal to the expenses incurred but not yet reimbursed by donors have been treated as contributions receivable.

v) Grants by way of various services rendered by the various Donor agencies have not been considered in these accounts.

vi) Fixed assets acquired upto August 1981 have been brought to account at material cost only. Subsequent to that date incidental expenses such as labour, freight, insurance etc (excluding clearing charges) have also been taken into account in arriving at the cost of fixed assets.

Depreciation on fixed assets has been charged on the "Straight Line" method based on the estimated effective span of life of such assets.

vii) Stock of stores and spares are valued at Invoice price. Stores and spares issued to Stations and Service Centres other than Matlab Station are expensed and the stock of such items remaining unconsumed at the year-end considered immaterial are not included in the closing stock.

viii) Lease rentals arising out of lease of Building have been recognised as income on a straight line basis over the tenure of lease.

ix) Currency conversion of non-US currencies to US Dollars. (a) for advances, liabilities (except interest free loan), cash and bank balances and for other transactions during December the year-end exchange rate is applied. (b) for transactions except as above, for the year, month beginning exchange rates are applied.

x) All assets costing US$50 or below have been depreciated in full by way of one time depreciation charge.

3. FIXED ASSETS

PARTICULARS	COST				DEPRECIATION				
	At January 1, 1989	Additions during the year	Disposals /adjustment during the year	Total at December 31, 1989	At January 1, 1989	Charge for the year	Adjustments during the year	Total at December 31, 1989	Net Book value as at December 31, 1989
Land	71,362			71,362					71,362
Buildings	1,866,663	89,316		1,955,979	334,837	102,581		437,418	1,518,561
Vehicles	525,934	171,063	70,843	626,154	458,651	56,227	70,828	444,050	182,104
Furniture	405,725	13,844,	3,554	416,015	273,236	66,834	2,969	337,101	78,914
Equipment	3,862,909	557,731	9,006	4,411,634	2,211,702	819,646	5,716	3,025,632	1,386,002
Capital Work in progress	487,309	429,376	86,479	830,206					830,206
1989 US$	7,219,902	1,261,330	169,882	8,311,350	3,278,426	1,045,288	79,513	4,244,201	4,067,149
1988 US$	6,140,418	1,092,073	12,589	7,219,902	2,425,484	862,159	9,217	3,278,426	3,941,476

i) Two plots of land measuring 4.10 and 0.51 acres situated at Mohakhali (Dhaka) and Matlab (Chandpur) received as donations from the Government of the People's Republic of Bangladesh and a private individual respectively have not been valued and included in these accounts.

ii) Cost of buildings includes an amount of US$103,488 spent for use by the Centre on the extension of the Institute of Public Health building, owned by the Government of the People's Republic of Bangladesh and which is at present partly accommodating the Centre. It also includes an amount of US$41,766 representing a Building let out on lease.

iii) Capital work-in-progress includes the cost of a transformer (US$24,926), installed in 1984, which could not be made operational due to non-availability of a required lubricant.

iv) No provision for depreciation has been made upto December 31, 1982.

v) Disposal of assets during 1989 includes an amount of US$12,625 being the assets of Mirzapur Hand Pump Project Phase II, returned to the donor.

4. STOCK OF STORES AND SPARES

		1989	1988
Supply stores (including stores in transit US$ 29,185; 1988 US$ 54,643)		330,863	300,364
Maintenance stores		133,993	112,568
		464,856	412,932
Other assets in transit		7,559	67,665
	US$	472,415	480,597

5. CONTRIBUTIONS

Donor	Advances/ (Receivable) as at 1.1.89	1989				1988 Income
		Received during the year	Receivable as at 31-12-89	Advances Carr-iedover to 90	Income for the year	
1	2	3	4	5	6	7
Core Funds:						
Australia		191,845			191,845	262,355
Bangladesh	(7,450)	37,288			29,838	30,340
Belgium	(24,045)	22,851	(49,929)		48,735	24,045
Switzerland		709,212			709,212	792,931
USA		300,000			300,000	275,000
UK		253,410			253,410	115,151
UNICEF		250,000			250,000	250,000
SAREC			(89,760)		89,760	
ICHF						2,649
Total Core funds (A)	(31,495)	1,764,606	(139,689)		1,872,800	1,752,471
Project Funds:						
AKF - Kenya & Henan Project	133,439	(69,582)		12,338	51,519	69,044
Australia - Nandipara Project	190				190	387
Australia - HBC study & Trainng		46,188		43,568	2,620	
Arab Gulf Fund	(235,440)	235,440				33,219
BRAC			(3,750)		3,750	
BOSTID/NAS	(12,771)	19,337			6,566	41,808
Belgium	158,931	137,104	(2,234)	22,469	275,801	147,552
Bayer AG - Ciprofloxacin		122,000		87,519	34,481	
Canada						
CIDA - DSS	(228,633)	1,106,021	(237,237)		1,114,625	1,101,087
CIDA - Training	138,162	47,640	(2,476)	20,878	167,400	47,802
Case Western Reserve University	(7,871)		(7,871)			192
Danida - CHP		662,957		225,574	437,383	511,989
Ford Foundation	133,894	39,226	(6,402)	31,998	147,524	176,285
French Embassy	14,964	11,445		16,138	10,271	15,012
IBRD/WB	(19,701)	25,110			5,409	144,404
IDRC - Infant mortality	(851)	5,366	(851)		5,366	
IDRC/ICDDR,B Fellowship		5,087		4,168	919	
DISC	(9,606)	57,629		28,601	21,422	50,913
ICHF - Training			(5,000)		5,000	7,840
Japan - CSD, LSD & TRN	85,088	380,000		150,170	314,918	224,912
Saudi Arabia	(406,300)	406,333			33	282,522
Kanton Hospital		9,880		9,880		
Miles Pharma.						12,918
Norway - NORAD - MCH/FP						
Matlab	214,842	395,913		289,000	321,755	271,497
Nestle						4,829
Norwich - Furazolidone	4,930			4,930		4,829
Netherlands Embassy	31,199	37,817	(42,537)		111,553	23,992
Sandoz Ltd.	4,000		(547)		4,547	
Searle - France	(7,209)	15,000	(20,299)		28,090	22,209

CONTRIBUTIONS (continued)

Donor	Advances/ (Receivable) as at 1.1.89	1989				1988 Income
		Received during the year	Receivable as at 31-12-89	Advances Carr-iedover to 90	Income for the year	
1	2	3	4	5	6	7
SDC - Training	(14,579)	14,579				
DISC, HD&SD	(46,577)	432,117		54,076	331,464	46,577
Emergency relief						4,738
Swiss/Basel University	2,000				2,000	
UNDP/WHO	(229,374)	300,000	(290,790)		361,416	493,185
UNDP/WHO - GOPP Workshop		12,138	(5,217)		17,355	
UNESCO - Training		3,099			3,099	
UNICEF	383	6,000			6,383	31,782
USAID/W-Coop. Agreement	87,182	2,001,925	(63)		2,089,170	2,408,245
Child Health/UVP	232,061	947,121	(22,574)		1,201,756	647,922
MCH/FP Extension	(322,290)	1,704,160	(5,488)		1,387,359	1,243,326
Training - Jakarta						30,200
WUSC - MCH/FP & Matlab	(27,114)	689,662	(79,770)		742,318	598,993
Wellcome Trust - Zinc study	(5,491)	17,228			11,737	36,969
WHO	94,009	175,814	(32,478)	60,884	241,417	165,996
Others	252	5,140	(1,597)	3,707	3,282	629.
Emergency Flood Relief:	100,583	354,474			455,057	363,911
Australian High Commission						
American Express Bank Ltd.						
Canadian High Commission						
Royal Denish Embassy						
Intl. ladies B.Society						
Netherlands Embassy						
Switzerland						
EEC Flood Relief						
USAID						
Total Project Funds(B)	(137,698)	10,359,367	(767,183)	1,063,897	9,924,955	9,262,896
Grand Total (A+B) US$	(169,193)	12,123,973	(906,872)	1,063,897	11,797,755	11,015,36[illegible]
Capital Development Fund US$						
UNCDF-Matlab Construction US$		272,159			272,159	526,420

5a. Contributions include US$ 5,366 received during the year from IDRC which relates to expenditure incurred in 1985 on Infant Mortality Project.

5b. Transfer during the year of US$ 912,310 to Capital Development Fund, includes capital expenditure of US$ 23,357 relating to previous year.

6. ADVANCES, DEPOSITS AND OTHER RECEIVABLES

		1989	1988
Advances to employees:			
- Official		72,800	97,372
- Personal		69,305	68,680
- Flood		110	373,363
- Other		44,701	57,308
		186,916	596,723
Operating advances to Projects (include cash and bank balances of the projects US$14,957; 1988 US$14,852)		32,846	29,882
Advances to Suppliers & Others		209,763	421,673
Deposits		3,681	3,728
Other receivables		3,684	-
	US $	436,890	1,052,006

7. DEPOSITS WITH BANK AGAINST RESERVE FUNDS

American Express Bank Ltd. -			
New York			
- Time Deposit		500,000	500,000
- Current Account		2,563	13,725
Dhaka			
- Time Deposit (includes accrued interest US$77,684; 1988 - US$50,219)		1,315,684	1,155,219
- Current Account		826	782
	US $	1,819,073	1,669,726

8. CASH AND BANK BALANCES

Cash in hand (Taka converted to US Dollar)		1,256	1,570
CASH AT BANKS:			
US$ Accounts			
American Express Bank Ltd. -			
New York			
- Current Account		150,726	-
Dhaka			
- Current Account		53,880	-
- Current Account (USAID - MCH) - 2nd cont.		137,168	-
- Current Account (BOSTID)		-	64
- Current Account (USAID - MCH)		94	818
- Current Account (USAID - UVP)		153,474	330,943
		495,342	331,825

CASH AND BANK BALANCES (continued)

		1989	1988
UK£ Account			
American Express Bank Ltd.,London			
- Current Account		26,988	3,549
Taka Account			
American Express Bank Ltd., Dhaka			
- Current Account (NORAD Fund)		333,116	315,763
- Current Account (Convertible)		13,259	5,015
- Current Account (UNCDF Fund)		75,097	89,144
Agrani Bank, Dhaka			
- Current Account		20,964	45,226
		442,436	455,148
	US $	966,022	792,092

9. BANK OVERDRAFT

US$ Account			
American Express Bank Ltd. -	New York	-	499,699
	Dhaka	-	3,574
Taka Account			
American Express Bank Ltd. -	Dhaka	-	752,223
		-	1,255,496

The overdraft is secured by a lien to the Bank on time deposits held with them on Reserve Fund Accounts.

10. INTEREST FREE LOAN

In May 1983, the Centre was provided by the Government of the People's Republic of Bangladesh with an interest-free loan of Tk. 28,928,775 (US$1,186,080 converted at the then exchange rate) initially for a period of one year. After several extensions by the Government the repayment date expired on June 30, 1986. In terms of the loan, the Centre is liable to pay interest at the prevailing commercial lending rate if the loan remains unpaid beyond the expiry of the period of repayment which at the option of the Centre can be effected either in Taka or in foreign currency. No provision for interest has been made in these accounts in this regard as the Centre holds the view that the loan should be converted into a grant as it was originally intended to be a grant to the Centre by UNROB and was utilized for providing free medical treatment to patients in Bangladesh as well as to provide free training to Bangladeshis.

11. OTHER CURRENT LIABILITIES

		1989	1988
For supplies and materials		212,739	205,086
For expenses (includes advance lease rentals US$50,303; 1988 - Nil)		1,347,953	868,469
Security and other deposits		62,334	50,176
	US $	1,623,026	1,123,731

12. CAPITAL DEVELOPMENT FUND

		1989	1988
Balance as at January 1		7,227,182	6,071,072
Add: Capital contribution received			
- in cash		258,266	526,420
- in kind		13,893	-
Transferred from the Statement of Income and Expenditure to the extent of Capital expenditure incurred during the year		912,310	629,690
	US $	8,411,651	7,227,182

13. OPERATING FUND

Balance as at January 1		(4,357,125)	(4,060,200)
Deficit for the year		(1,078,181)	(296,925)
	US $	(5,435,306)	(4,357,125)

14. RESERVE FUND

Balance as at January 1		1,669,726	1,552,920
Add: Interest earned on deposits (including accrued interest of US$77,684; 1988:US$50,219)		149,347	116,806
	US $	1,819,073	1,669,726

15. EMPLOYEES RETIREMENT FUND

i) The centre operates a retirement fund called "ICDDR,B Employees Separation Payment Fund" for all National employees with GENERALI GROUP of UK under an agreement between ICDDR,B and Institute of International Education (IIE), USA. During the year the Centre and staff members contributed 14.8% and 7.4% of the base pay respectively to the fund. The amounts so accumulated are remitted to GENERALI GROUP through IIE on quarterly basis by the Centre. The GENERALI GROUP is empowered to invest the fund available with them as considered profitable by them and at the end of each calender year the profits earned out of these investments are distributed among the staff members' accounts. Such accumulated fund which at December 31, 1989 was estimated at US$ 4,510,520 is not reflected in the books of account as it is not considered as a part of the Centre's assets.

ii) The Centre operates a fund called "ICDDR,B Severence Pay Fund" for Community Health Workers since July 01, 1987 which fund is not reflected in these accounts. The balance of this fund stands at US$55,367 as on December 31, 1989.

16. HONORARIUM

Mandatory committee meetings include an amount of US$27,145 (1988: US$26,217) paid as honorarium to the members of the Board of Trustees.

17. OTHER RECEIPTS

Out of the total consideration of US$ 67,824 receivable against letting out of one of the Centre's Buildings on lease to Agrani Bank for a period of ten years, an mount of US$ 565 have been

considered as income for the year and included under `Other Receipts'.

18. CURRENCY TRANSLATION

Currency	Average monthly exchange rates	Year-end exchange rate
	US $	US $
Tk. 1.00	0.0314	0.0314
UK £ 1.00	1.6581	1.6146

19. OTHERS

Previous year's figures have been rearranged and regrouped to conform to current year's presentation.

Figures appearing in these Accounts have been rounded off to the nearest US dollar.

Director
ICDDR,B

Member
Board of Trustees

APPENDIX B

ACRONYMS AND ABBREVIATIONS

ARTI	Acute respiratory tract infections
BADC	Belgian Administration for Development Cooperation
BCSIR	Bangladesh Council of Scientific and Industrial Research
BOSTID	Board on Science and Technology for International Development
BRAC	Bangladesh Rural Advancement Committee
CDC	Centers for Diseases Control
CHD	Community Health Division
CDD	Control of Diarrhoeal Diseases
CH	Contact haemolysin
CHP	Child Health Programme
CHW	Community Health Worker
CIDA	Canadian International Development Agency
CIS	Computer Information Services
CPU	Central processing unit
CRC	Clinical Research Centre
CSD	Clinical Sciences Division
DANIDA	Danish International Development Agency
DISC	Diarrhoeal Diseases Information Services Centre
DSS	Demographic Surveillance System
EAggEC	Enteroaggregative *E.coli*
ECPP	Epidemic Control Preparedness Programme
EHEC	Enterohaemorrhagic *E.coli*
EIEC	Enteroinvasive *E.coli*
ELISA	Enzyme-linked immunosorbent assay
EPEC	Enteropathogenic *E.coli*
EPI	Expanded Programme of Immunization
ERC	Ethical Review Committee
ETEC	Enterotoxigenic *E.coli*
FAO	Food and Agriculture Organisation
FWV	Family Welfare Visitors
IBM	International Business Machines
IBRD	International Bank for Reconstruction and Development
ICDDR	International Centre for Diarrhoeal Disease Research
IDRC	International Development Research Centre (Canada)
IPGM&R	Institute of Post-graduate Medicine and Research
IPH	Institute of Public Health
JDDR	*Journal of Diarrhoeal Diseases Research*
LSD	Laboratory Sciences Division
LT	Heat labile toxin
MCH/FP	Maternal and Child Health - Family Planning
NGO	Non-governmental organisation
NIPORT	National Institute of Population Research and Training
NIPSOM	National Institute of Preventive and Social Medicine
NORAD	Norwegian Agency for Development
ODA	Overseas Development Administration (UK)
OPEC	Oil Producing and Exporting Countries
ORS	Oral rehydration salts; oral rehydration solution
ORSTOM	*Institut Français de Recherche Scientifique pour le Développement en Coopération*
ORT	Oral rehydration therapy
PCC	Programme Coordination Committee
PSED	Population Science and Extension Division
RKS	Record Keeping System
RRC	Research Review Committee
SAARC	South Asia Association for Regional Cooperation
SAREC	Swedish Agency for Research Cooperation with Developing Countries
SDC	Swiss Development Co-operation
SRS	Sample Registration System
ST	Heat stable toxin
SWA	Staff Welfare Association
UNCDF	United Nations Capital Development Fund
UNDP	United Nations Development Programme
UNFPA	United Nations Fund for Population Activities
UNICEF	United Nations Childrens' Fund
UNROB	United Nations Relief Organisation in Bangladesh
US AID	United States Agency for International Development
UVP	Urban Volunteers Programme
WHO	World Health Organization
WUSC	World University Service of Canada

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Facsimile: 883116

RESEARCH FACILITIES AT THE ICDDR

Bangladesh has many major health problems in common with other developing countries, such as diarrhoeal diseases and malnutrition, and is a country facing the same predicament: it has widespread poverty and ignorance, an increasing population, and a health system poorly equipped to respond to these challenges. The Centre is therefore in an exceptional position to conduct research in a natural setting on the problems of diarrhoea, nutrition, fertility and public health.

Clinical facilities

A large number of patients with diarrhoeal diseases attend the Centre's two hospitals each year, one in urban Dhaka, the other in rural Matlab. The Clinical Research Centre in Dhaka has a 25 bed research ward, a 10 bed metabolic ward, specific wards for persistent and invasive diarrhoea, and a laboratory to provide a wide range of biochemical and microbiological tests.

Research laboratories

There are well equipped and well staffed laboratories for research in bacteriology, bacterial genetics, histopathology, immunology, molecular biology, nutritional biochemistry, parasitology, and virology. The Centre has a walk-in cold room and freezer, facilities for growing and isolating pathogens, liquid nitrogen freezers, a large animal house and many items of test equipment including a mass spectrometer, a gas-liquid chromatograph, a high performance liquid chromatograph and a centrifugal analyser.

Demographic surveillance

Information collected on vital events concerning 200,000 people in the Centre's Matlab field area over the last 25 years currently provides an unrivalled opportunity to study demographic trends, to investigate the epidemiology of ill-health, and to examine the effect of providing new health services on morbidity and mortality.

Computing facilities

The Centre operates an IBM 4361 mainframe computer with eight megabytes (MB) of real memory and an on-line storage capacity of 3,000 MB connected to 25 terminals. This system provides a capacity to analyse large data sets and is complemented by over 100 personal computers scattered throughout the Centre.

Diarrhoeal Diseases Information Services Centre (DISC)

DISC provides access to the scientific literature on diarrhoeal diseases, population studies and health in general by means of CD-ROM databases, 21,500 books and bound journals, over 10,000 reprints and documents, and subscriptions to 420 current journals. DISC publishes the quarterly *Journal of Diarrhoeal Diseases Research*, annotated bibliographies, a newsletter and monographs.

Staff

The Centre currently has over 200 scientific researchers and medical staff from more than ten countries doing research and providing expertise in the many disciplines related to the Centre's areas of research.