

INSTITUTE OF CURRENT WORLD AFFAIRS

CHGO-6
Hong Kong's Water Problem.

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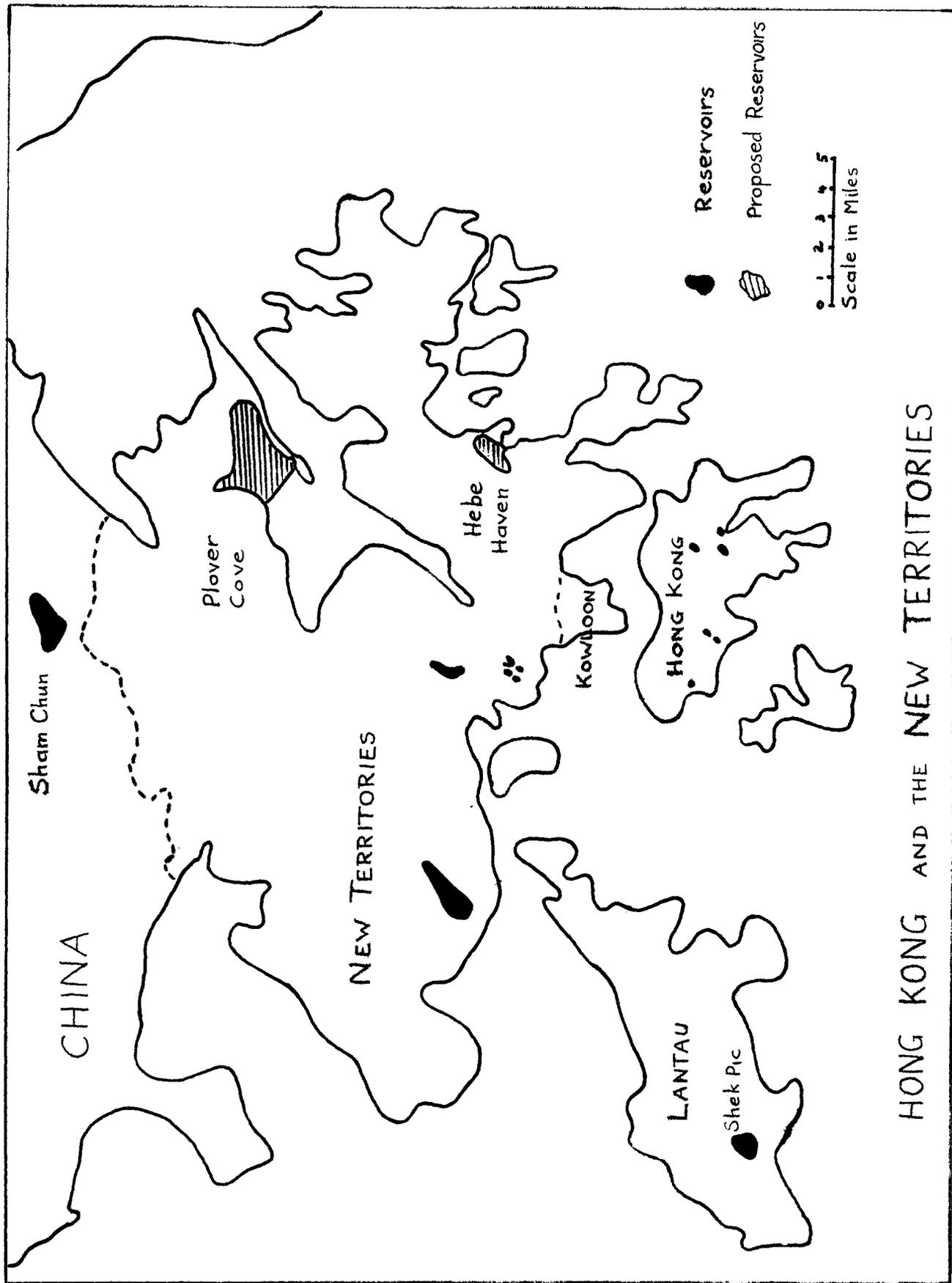
Dear Mr. Nolte,

A year or so ago I remember hearing a distinguished American geophysicist give a lecture about a new geophysical method for finding underground water. In the lecture he said that America was rapidly exhausting its water supplies and predicted that within fifty years there would be more geologists and geophysicists exploring for water than exploring for oil. At the time this seemed a pretty sweeping statement and it soon went out of my mind. But it was recalled, and its importance and significance really struck home, when I came to live in Hong Kong; for Hong Kong has a water problem, and the main purpose of the present letter is to discuss this problem. But it may also serve as a reminder of what could happen elsewhere in the world if insufficient support is given to local water programs.

The Hong Kong water problem is simply that there is insufficient fresh water. There has been insufficient water almost from the beginning, (at least from the time that the island of Hong Kong was permanently ceded to the British by the Treaty of Nanking in 1842), and it looks as though there will be insufficient water right until the lease on the New Territories expires in 1998. At this time 92% of the Colony's land area will revert back to China.

The reasons for the shortage are obvious enough. On the one hand the Colony is comprised of 398 square miles of mostly hilly and mountainous terrain; it has no natural lakes and no large rivers; and three-quarters of its annual rainfall of 85 inches fall in the five summer months of May through September. On the other hand Hong Kong is one of the most densely populated spots on the earth, with a population density of 8,000 people per square kilometre (compared with Japan's 252 and India's 134), and in addition it is becoming increasingly industrialised.

It has been estimated that the Colony's needs at the present time are 90 to 100 million gallons of water a day, whereas during the winter months only 50 to 60 million gallons a day can be supplied. The result is water rationing. At present (January 1962), water is available 8½ hours a day, from 6am to 10am and from 4pm to 8.30pm. During this time there is an unlimited supply and most householders fill all possible containers with water. At first it surprised me that this system of rationing actually saves



HONG KONG AND THE NEW TERRITORIES

water, because the natural inclination is to run off more than is actually needed, but I recently discovered that we live in an area which has a good distribution system. This means that when the water is 'on' our water pressure is high and we are able to run off as much as we want. There are other areas in Hong Kong where the waterworks distribution system is not so good, the water pressure is low, and even when the water is 'on', only a trickle flows, so that it is impossible to hoard the water. As the distribution system is improved throughout the city, limiting the hours of supply becomes a less effective way of rationing. This is borne out by the fact that during the first three months of the 1961-62 winter season, when water was available ten hours a day, the daily consumption was 65 million gallons, A year ago the daily consumption during the same period, and with a ten hour supply, was only 55 million gallons. This is almost a 20% increase, and in the opinion of the Government water engineers it is most likely explained by the improvements made in the distribution systems during the year. Further evidence came in this morning's newspaper which gave the water consumption figure for the past week. It averaged 65 million gallons a day, which is the same as it was before the recent curtailment to an 8½ hours daily supply.

It must be admitted that the rationing involves no real hardship for the more affluent dwellers in Hong Kong, but for many of the Chinese, whose only supply of water is from public stand pipes, it often means long hours of queuing. The effect water rationing has had on the economic development of Hong Kong is difficult to judge, and as far as I know the subject has not been studied in detail. In the new industrial communities the Government has tried to insure that industry has a twenty-four hour supply, but at the same time has insisted on water conservancy measures being taken wherever possible. For example, water is not allowed for air conditioning purposes. In the more established areas where it is difficult to duplicate water mains, industrial concerns have either had to sink their own wells, or apply to the Government for permission to install large storage tanks. It has been a difficult problem for the Government to assess the merits of all those who apply for water tanks. For example, should barber shops and restaurants be given the right to install tanks? In most instances the answer has been 'no' to these establishments. The lack of water for irrigation is another impedance to the economic welfare of the Colony. Sufficient improvements in farming methods have been introduced by small scale irrigation to show how much more could be achieved in agriculture if only sufficient water was available.

I mentioned earlier that ever since Hong Kong has been inhabited there has been this water problem and the history of the Colony is punctuated by water crises. The first major crisis came in May 1902 at a time of cholera and bubonic plague. On this occasion water was rationed to one hour a day. Then, in June 1929 came the next major crisis when five out of the six reservoirs then in existence were almost dry. Water was even brought by ship from Macao and Shanghai. At this time water was rationed to 6½ gallons per person per day - normal consumption in Hong Kong is approximately thirty gallons a day. More recently, in 1956, water was available

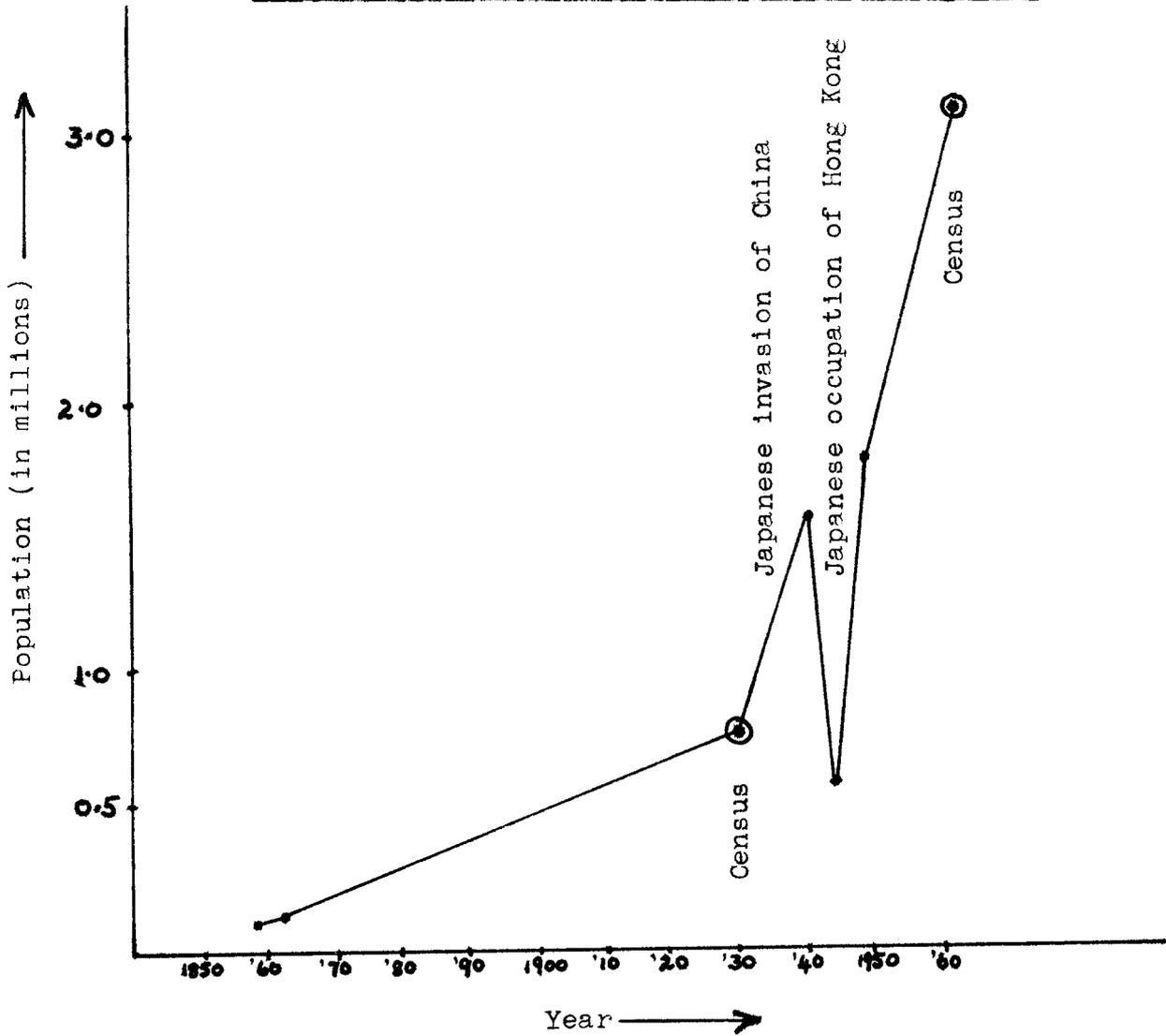
for only $2\frac{1}{2}$ hours every second day.

All this leads to the question: "Why, if the problem has been in existence for so long, has it not yet been solved?". The answer seems to be a combination of lack of foresight on the part of the Government and natural difficulties on the part of Nature. We can sympathise to a certain extent with the lack of foresight - it would surely have been impossible to predict the political events which led to the inflow of refugees during the Japanese war in China, and again after the Communists' victory there. The growth in population is vividly shown on the accompanying chart which is based on the two census returns of 1931 and 1961, together with various official and unofficial estimates in between.

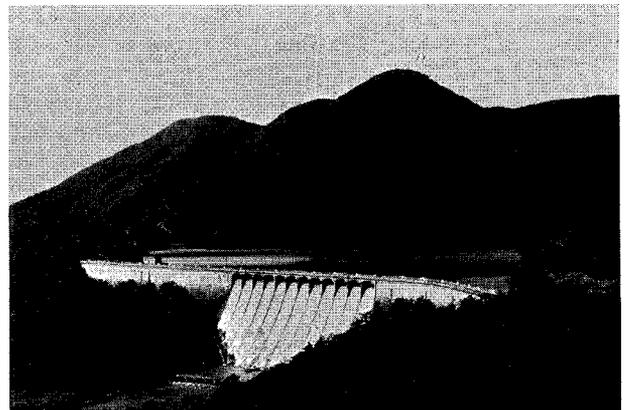
Let us take a closer look at what has been done, is being done, and what could be done, to solve the Hong Kong water problem. It is obvious that the solution must initially follow one of two alternatives. Either the number of people must be reduced or the amount of water must be increased. Although the first alternative was actually carried out by the Japanese during their occupation (see chart) it is hardly a policy which is likely to be put into effect by the present government. It is always possible that an economic slump in the West, coupled with an economically thriving China, would produce a voluntary migration of many Chinese back to China. This would have the desired effect of reducing Hong Kong's population, but it is not a factor which can be seriously considered in seeking a solution to Hong Kong's water problem. Therefore the amount of water must be increased. This can be done in one of several ways. The excess summer rain water can be conserved in reservoirs; underground water can be tapped; sea water can be used for some purposes; fresh water can be obtained from sea water; or water can be obtained from outside the Colony.

The most obvious solution is the first one, namely to conserve the summer rainfall in reservoirs. The first reservoir was completed in 1863, just twenty-one years after the Colony was established. Since that time there has been a steady increase in the number and size of the reservoirs until there are now thirteen of them with a total capacity of 10,500 million gallons. The biggest of the lot is still under construction on Lantau Island at Shek Pic. When completed in 1963 it will add a further 5,400 million gallons storage capacity and be able to supply Hong Kong with water at the rate of twenty-six million gallons a day, thus making a possible total daily supply of about 80 million gallons. But even this will fall far short of the predicted 1963 requirements of up to 120 million gallons per day. The Government have therefore been considering a unique and fascinating scheme for damming two inlets of the sea, one at Plover Cove and the other at Hebe Haven, both on the highly indented eastern shore of the New Territories (see map). Damming completed, sea water would have to be pumped out and huge fresh water lakes formed in its place. It is estimated that the damming project would take seven to nine years to complete with a further two years for the sea water to be replaced with fresh. If this project is approved it will add another 100 million gallons a day to Hong Kong's water supply, but it will also cost well over \$100 million U.S. dollars to complete. The detailed report on this Integrated-Plover Cove-Hebe Haven

GRAPH SHOWING GROWTH OF HONG KONG'S POPULATION



A rare sight in Hong Kong ...
 Tai Tam Reservoir
 overflowing, September 1961.



project is expected to be ready for presentation to the Government within the next few months. Hence some time during this year the decision will have to be made on whether or not to go ahead with the project. All things considered it is difficult to see how the Government can refuse to give its financial blessing.

This brings us to the second possible source of water - underground water. One inch of rain falling on one square mile of land yields $14\frac{1}{2}$ million gallons of water. Hong Kong's annual rainfall is 85 inches, and its area is 398 square miles. Thus the total available supply should be about 500,000 million gallons. On the average, about 10% of rainfall finds its way into the ground. This would give Hong Kong a potential annual supply of about 50,000 million gallons of underground water. Some of this is tapped by shallow wells for flushing purposes and irrigation, but no large scale use is made of underground water. The Government claims that it has investigated the matter and found no evidence of large scale supplies. It is true that during 1957-59, fifteen wells, ranging in depth from 60 to 350 feet, were drilled in the New Territories with negative results, but Dr. G.C. Riley, the lecturer in geology at the University of Hong Kong, claims that insufficient geological and geophysical work has been done to site test wells properly. He maintains that until more detailed geological and geophysical studies are undertaken the possibility of there being considerable underground water cannot be ruled out. Dr. Riley is on strong ground in making these statements. Two major requirements for underground water are porous reservoir rock, and suitable geologic structures for trapping the water. There is plenty of evidence that porous rock exists, but until more detailed mapping is carried out no one knows whether suitable structures and groundwater basins are present. A combined geological-geophysical survey would cost about 1% of the sum contemplated for the Hebe Haven-Plover Cove scheme. Yet the Government has shown no evidence of its intention to carry out such a survey.

The third way of - in effect - creating more water, is to use sea water for those purposes for which fresh water is not essential. Firefighting and toilet flushing fall into this category, and in some parts of Hong Kong special sea water mains have been installed for these purposes. If extended this could save a great deal of water since it is estimated that nine gallons of water a day per person are used for flushing.

Fourthly, there exists the possibility of providing commercial supplies of fresh water by distilling sea water. The Government has kept this possibility in mind for a number of years, and on three separate occasions has undertaken feasibility surveys. The first occasion was before the War, the second shortly after the War, and most recently in 1959 when the possibility of using nuclear power was considered. On each occasion it was decided that there was no prospect of producing worthwhile quantities of distilled water at anything but a prohibitive cost. The 1959 study showed that it would cost \$6 H.K. to produce 1,000 gallons of fresh water by distillation methods, as compared with the current charge of \$1 H.K. per 1,000 gallons of fresh water obtained by more conventional methods.

The fifth way of supplying Hong Kong with water is to bring it in from outside. This was done in 1929 by ship from Shanghai and Macao, but this obviously can only be an emergency measure. In 1959-60 the Peoples' Republic of China constructed a large reservoir at Sham Chun, about two miles beyond the border. Early in 1960 they let it be known that they were willing to supply some of this water to Hong Kong and on November 15, 1960 an agreement was signed between the British and Chinese authorities whereby China was to supply about 5,000 million gallons of water a year, mostly during the dry winter months. This water has been flowing into the Colony since December 1960. At the present time, 27 million gallons of water a day are coming from China and this is almost half of Hong Kong's daily consumption. In the summer the supply from China is less than this, and on an annual basis amounts to about 20% of the total Hong Kong water consumption. (The story is told in Hong Kong of the American visitor who, when learning that the water he had been drinking was from China, spluttered in horror "Do you mean to say I've been drinking Communist water? - Now I'll never be allowed back into the States!").

What of the future? During the past decade Hong Kong's population has been increasing at the rate of 4.4% per year. This is partly due to the influx of refugees and it is unlikely that the population will continue to grow at this alarming rate, but we must remember that the average annual population increase for Asia is 3%, and this is also the rate at which births exceed deaths in Hong Kong. We are therefore on pretty safe ground in predicting that Hong Kong's population will double in the next twenty to thirty years; and with it the water requirements will certainly more than double. Assuming that the Plover Cove and Hebe Haven schemes are approved, this will add a further 75 to 100 million gallons a day to the water supply, boosting it to (let us take the most optimistic figure) 175 million gallons a day. But within a few years of completion of this scheme Hong Kong's water needs will be in excess of 200 million gallons a day. Thus in 15 years time Hong Kong will again be facing a serious water shortage. What can she do then? Similar damming projects would be unprofitable because the intricate system of concrete catch waters and tunnels will have tapped most of Hong Kong's economically available run off water. (This system of tapping virtually the whole available surface water is, incidentally, unique to Hong Kong. Nowhere else in the world are the hillsides riddled with such a network of water traps all draining into reservoirs). Increased use of sea water will help a little. Underground water however, is an unknown factor and as such warrants further attention. This leaves distillation of sea water and more supplies from China as the other alternative sources of water. Distillation of sea water is too expensive at the present time, but fifteen years hence it may be an economic proposition. It seems probable that this will be a method used for solving Hong Kong's future water problems.

There remains however, the possibility of obtaining more supplies from China. This possibility must be considered with the realization that in thirty-six years, when the lease expires, China will take over the New Territories which will then contain the major sources of Hong Kong's water. If at that time the

CHINESE WATER
FOR HONG KONG ...

A part of China's Sham Chun Reservoir can be seen among hills in the background. The river marks the border between Hong Kong and China. The photograph was taken from Robin's Nest, a 1,610 foot hill in the New Territories.



permanently ceded island of Hong Kong and Kowloon Peninsula remain a British possession then they will be totally dependent on China for water. If on the other hand China takes over the whole Colony, she herself will inherit the water problem. In any event, when thinking of water for Hong Kong for the period beyond twenty years from now, the possibility of persuading China to supply more of it must be seriously considered.

Sincerely,

C.H.G. Oldham

C.H.G. Oldham.

P.S. After completing the newsletter I came across a report on the 7th Pugwash Conference on Science and World Affairs which was held at Stowe, Vermont during September, 1961. Previous Pugwash conferences have been concerned with preventing the misuse of science in the destruction of mankind. This conference however, took a more positive line and discussed constructive international co-operation in science. It was felt that international co-operation is a way to create trust among nations, a trust which develops from common interests and from experience in working together. The forty-one eminent scientists from eleven countries recommended a number of specific proposals, among which was one which has a bearing on this newsletter. I quote from the report in the December 30, 1961 issue of the British science journal "Nature":

"The rising world population and the concentration of that population in metropolitan centres is already pressing on water resources easily available for direct human consumption, for industrial purposes and for agriculture. It was agreed that an international conference should be called to consider the organization of an international hydrological decade for the study of the many unknowns that surround this ominous development".

Hong Kong could have much to contribute to such a study.

CAGD.