A Resume of Biotechnology in China

President, Chinese Society for Microbiology **Dr. J.S. Chiao**

On behalf of the organizing committed and colleagues of Shanghai Society for Microbiology (SSM), I would like to express my sincere welcome to friends from Korea. The opening of diplomatic relations last year between China and the Republic of Korea is a major event of the history of the two nations. The new relations without doubt will be conducive to people's mutual visit, including exchange in science and technology. Last October I had the opportunity to participate the Annual Meeting of Korea Society of Applied Microbiology and appreciated very much the warm welcome of Korean friends. During my visit to Korea, Dr. Mheen and Dr. Nangoong asked me to start a bilateral applied biotechnology conference not later than March. This suggestion is warmly welcomed by colleagues of our Society. So, we are here having the first bilateral conference on biotechnology. I sincerely hope Korean friends enjoy the meeting and the short stay in Shanghai. Any inconvenience and suggestion during your stay please let me know.

Now, it may be proper for me to take this opportunity to say something on biotechnology in China.

I'd like to tell several aspects relevant to our biotechnology;

1. Government policies on the development of biotechnology.

2. The 7.5 & 8.5 strategic plans, and the High Technology Program (code name 863).

3. To-day fermentation industry.

Our government is well aware of the value of high technology achievement in accelerating the industrialization of national economy, and consequently biotechnology is considered as the first item among the eight stressed fields of high technology. In order to realize this strategic decision several measures have been taken.

i) Creation of a leading and coordinating organization for biotechnology. In 1983 National Centre for Biotechnology Development under the State Commission of Science and Technology was established as the leading and coordinating organization. The main objectives of the centre are to formulate policy and programme for the development of biotechnology, to organize priority research projects, to coordinate research work of different institutions and to organize international exchange and cooperation.

ii) Establishment of modernied bases for the development of biotechnology. These bases will be provided with modern equipment as well as a group of experienced and young research workers and will be open to the outside world. Foreign scientists and experts will be welcome to participate in the management and research development of these bases. This institute Shanghai Research Center of Biotechnology (SRCB), is the first of these bases.

iii) Acceleration of training of qualified personnel.

iv) Development of international cooperation in science and technology under the policy of ope-

ning to the outside world.

v) Organization and coordination of concentrated effect on priority projects. Based upon various considerations, the fellowing fields are primarily selected as priorities for the immediate future:

1) Application of fermentation technology to medico-pharmaceutical, food and animal feed industries.

2) Application of enzyme technology to medico-pharmaceutical, food and light industries.

3) Application of plant cell and tissue culture techniques for the rapid propagation of seedlings and cultivars in agriculture.

4) Application of monoclonal antibody to clinical diagnosis and to the separation of biologically active substances.

5) Production of vaccines for hepatitis, viral and bacterial diarrhea and peptide hormones for human and for animals.

Under the guidance of these considerations the Seventh Five year Plans (1985-1990) on Biotechnology and High Tech Program (863) were inaugurated. The former one is the most extensive program and consists of 156 projects. I have the opportunities to participate these discussion and assessment of many projects. May I list some of them.

We are very much in need of HBsAg vaccine and HBsAg has been expressed in several systems, and products from two systems are in pilot production and passed the mother-baby interruption test. Interferons (α, αZα∏ γ) are in pilot production and clinical tests. Besides these pharmaceutical products, I must add an industrial enzyme, penicillin G acylase. The genetic engineered *E. coli* is working in hollo fibre bioreactor in Dong-Feng Pharmaceutical Factory in Jiang-Xi province. Dr. Yang is going to lecture more about it.

Agricultural applications of genetic engineering include

K88 K99 piglet vaccine
Swine growth hormone
Anti-TMV, Anti-CMV tobacco
Anti-CMV tomato
Anti-DVX potato

All those are undergoing field-test now.

So much for genetic engineering projects, now I'd like to tell you some progress in plant cell biology.

China is advanced in plant cell biology and research carried in the seventh-five year plan is also extensive;

Anther cultures (rice, wheat, rape, tobacco, rubber trees).
Protoplast cultures and cell hybridization.
Somato-clonal variation and mutant cell screening.
Test-tube rapid propagation and virus removal.
Tissue cultures of medicinal herbs.

Finally we have the hybrid rice. In China, hybrid rice has been cultivated extensirely to boost rice production, statistical data for 1981-1990 showed that the average increase in comparison with pure cultivar amounts to 29-45%. In 1991 the acreage of hybrid rice reached 17600000 hectares, corresponding of 55% of total rice area.

So much for the Seventh-Five Year Plan (1985-1990). You may wonder about the Eighth-Five Year Plan (19910-1995). It is less far-reaching, bur with a feature of stressing pilot and pre-production projects.

The more complicated projects and some basic aspects for the development of biotechnology are included in the High Technology Program.

I should add that application for projects of the Seventh-Five Year Plans, Eighth-Five Year Plans and the High Technology Program is ictly on competitive basis.

Next, let's come to the fermentation industries.

In early 1950's, antibiotic industry was first established in our country. Production of amino acids, enzymes, citric acid, vitamins, steroid hormones, nucleosides, solvents and yeast by fermentation were subsequently started.

At present, antibiotic production has became a large enterprise, the total tonnage amounts to one fourth of the total world production. Of all the

antibiotics, 60% belongs to the tetracycline series, and that of β-lactam antibiotics counts a few percentage. The total varieties reach about one hundred, including the following groups:

Penicillins, cephalosporins
Tetracyclines
Aminoglyeosides
Chloramphenicol
Macrolides-erythromycin, spiramycin, medicamycin
Rifamycins
Lincomycin
Polyethers
Antifungals, antitumors

For clinical purposes β-lactams are the first choice, and consequently much effort has been directed to boost the yields of penicillin G and cephalosporin C, and to develop enzymatic conversion of these parent substances to 6-APA and 7-CAC for semi-synthetic products. In addition, some better equipped penicillin lants are using on-line measurement with automated regulation and monitoring system to provide optimum fermentation conditions.

Production of MSG began in the early 60's. At present, there are more than 200 plants engaged in this process, and the total output for 1991 reached 250000 tons. However, our technology used in MSG production has much to be desired, the adaptation of advanced techniques and installations are imperative.

The next amino acid produced by fermentation is lysine. The international demand for lysine has been increasing in recent years because of the expanding requirement for feed supplement. In China, demand of this essential amino acid is increasing rapidly too. Other minor amino acids include aspartic acid, alanine, isoleucine, threnine, and total output amounts to 1000 tons, which are not enough to meet domestic requirement.

Enzymes are also produced in large scale. The major varieties ar α-amylase, amyloglucosidase and alkaline protease. These products are mainly used in alcohol fermentation and brewing, which consume about 50% and 405 of all industrial enzymes, respectively. New additions to industrial enzymes are thermal stable α-amylase, neutral protease, β-glucanase, etc

Citric acid is the largest organic acid in fermentation industry, a yearly production reaches several thousands tons, mostly exported. The important feature of Chinese citric acid fermentation is the utilization of crude starch instead of purified glucose, apparently our cultures are resistant to heavy metal ions. The yield of acid amounts to 13-16%, rate of conversion is avove 95%, and there is no other acid accompanying citric acid.

The weak point of our citric acid fermentation is the downstream processing, the age-old Ca-salt method is still in use. Alternatives (extractive process) have been studied, however, they are not likely to be adopted for food citric acid.

Other minor acids in production are DL-lactic acid, gluconic acid, and itaconic acid. L-malic acid by immobilized cell is going to be produced.

Steroids: In China, steroid drugs stand only nest to antibiotics in their sale value. Up to now, the following varieties are available: cortisone, hydrocortisone, Prednisone, Prednisolone, Triamcinolone, Dexame thasone, Betamethasone, Estrone, Testosterone, etc. Because of the easily available raw materials such as cassava, the development of steroid drugs has been fast.

% As presented it's a brief introduction of the R and D in biotechnology and bioindustry in China. We have our merits and demerits too. For further development, we need more basic research and engineering studies. The opening of conferences like this one is one way for us to learn from our foreign colleagues, this time from scientists coming from a land separated from us only by a stripe of water.

That's what I want to say. Thank you.