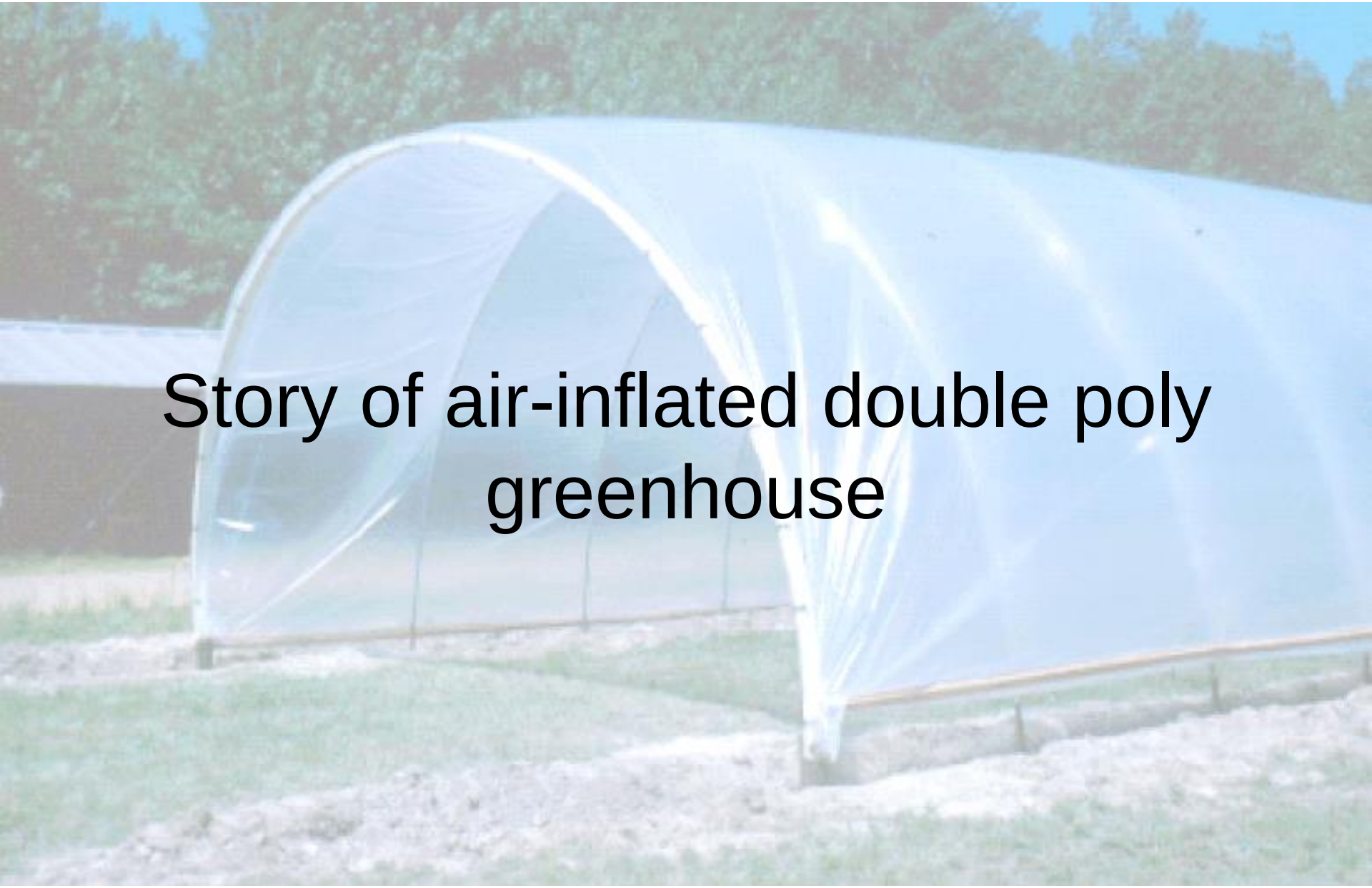
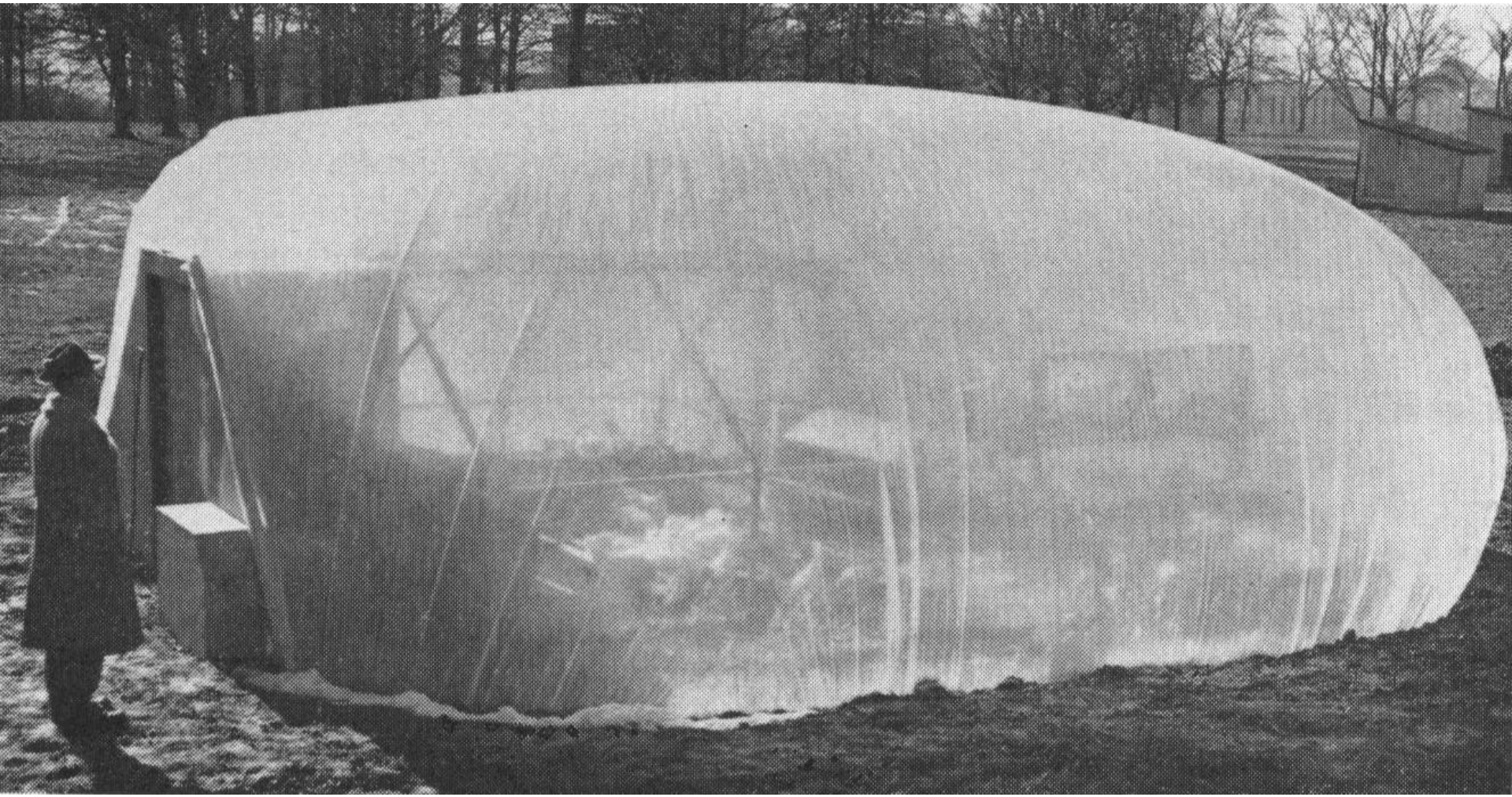
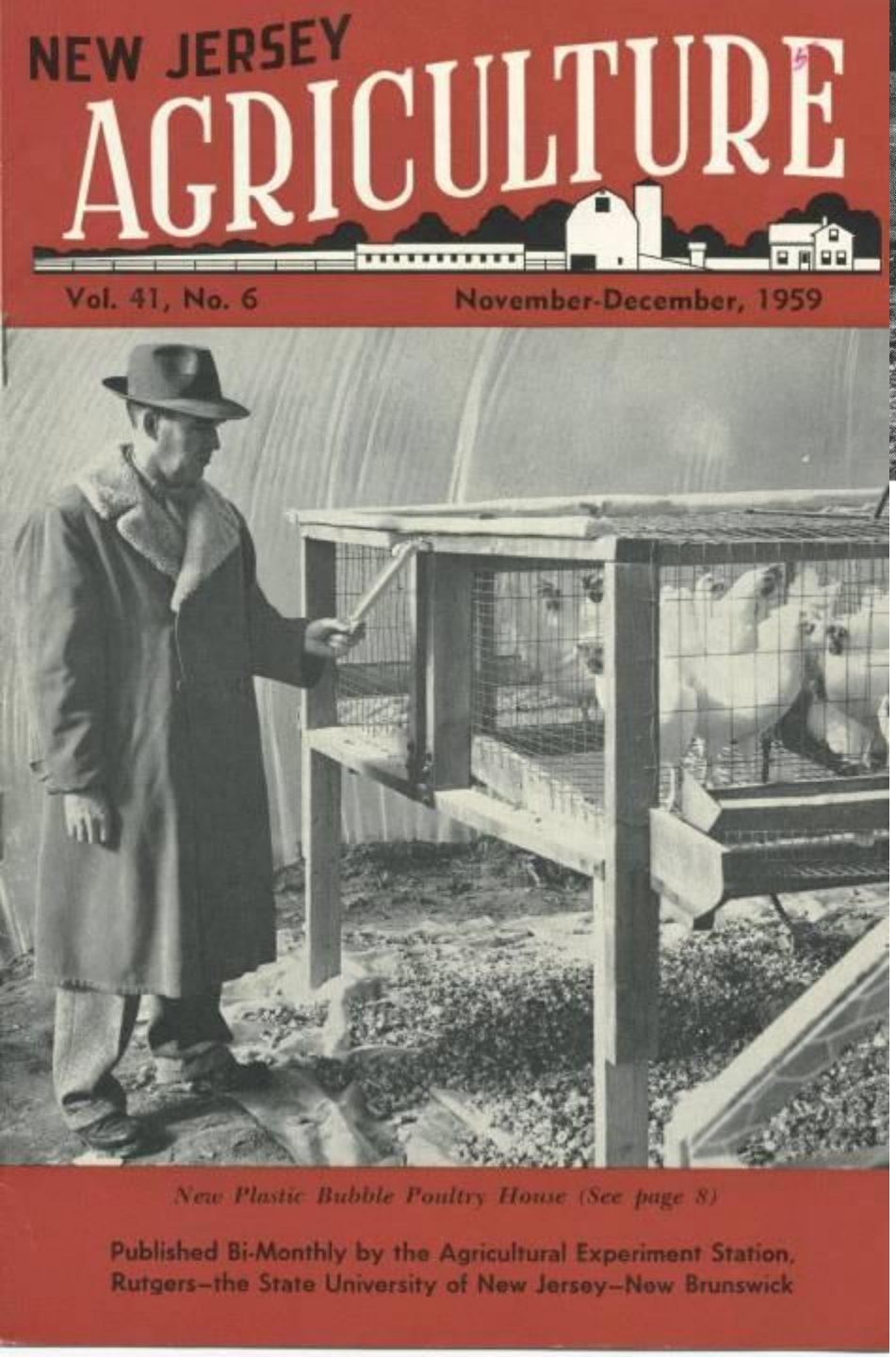


Story of air-inflated double poly greenhouse

Wei Fang, Professor, National Taiwan University

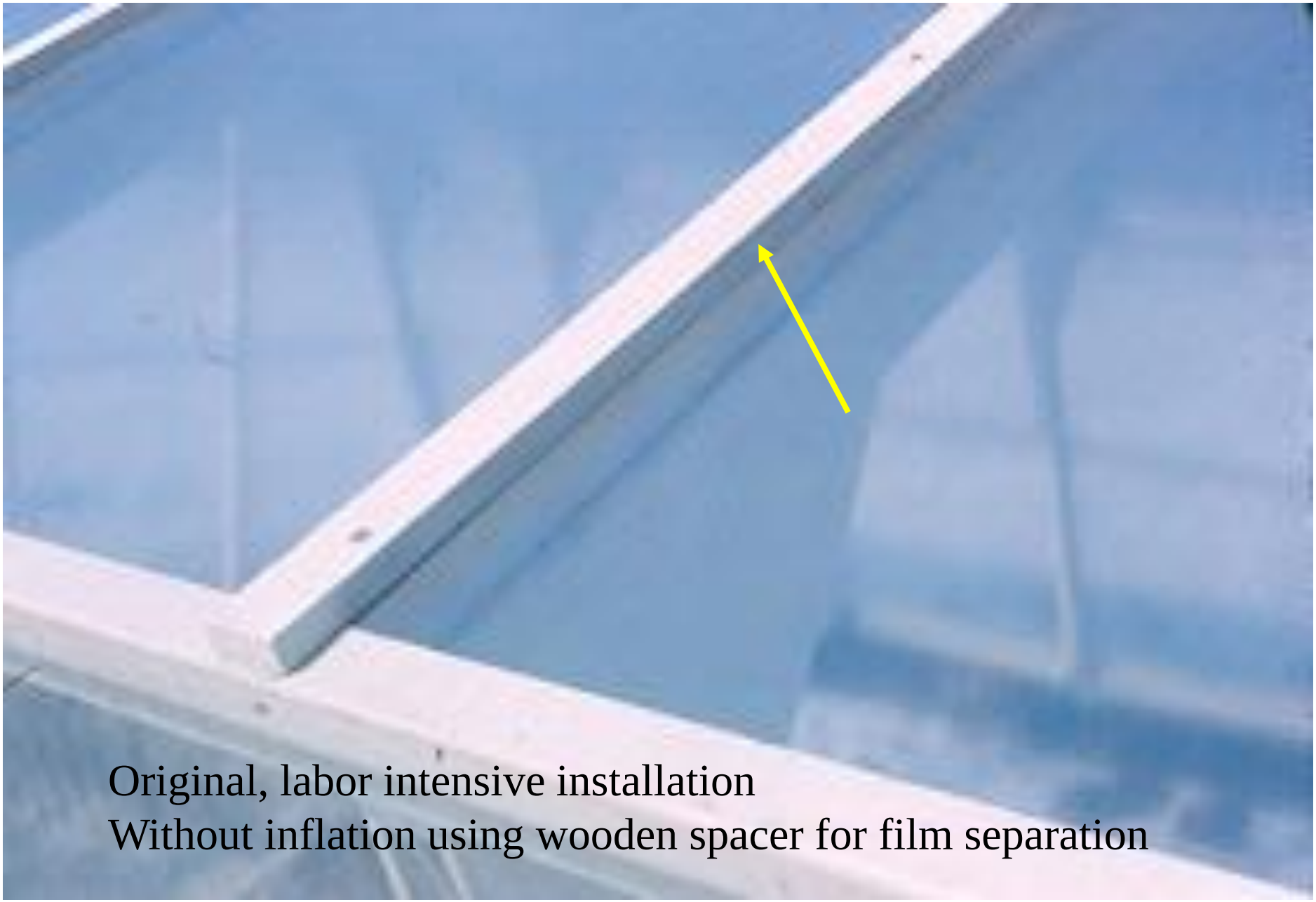


First Rutgers air supported structure 1957
Study of diurnal stress on poultry



Prof. Reed and his first air supported bubble house. The first version of this was in 1957 beside the cottage where graduate students lived. They took care of the chickens for the poultry stress response test in exchange for the eggs.

Early single glazed structures dripped: a second layer is needed



Original, labor intensive installation
Without inflation using wooden spacer for film separation

History started

- Developed In 1964
- Roberts, W.J. and D.R. Mears. **1968**. **Double Covering a Film Greenhouse Using Air to Separate Film Layers**. ASAE paper 68-402. Presented at Logan, Utah.

- Published in Transactions of the ASAE V12, No.1 **pp.32, 33, 38**. **1969**.

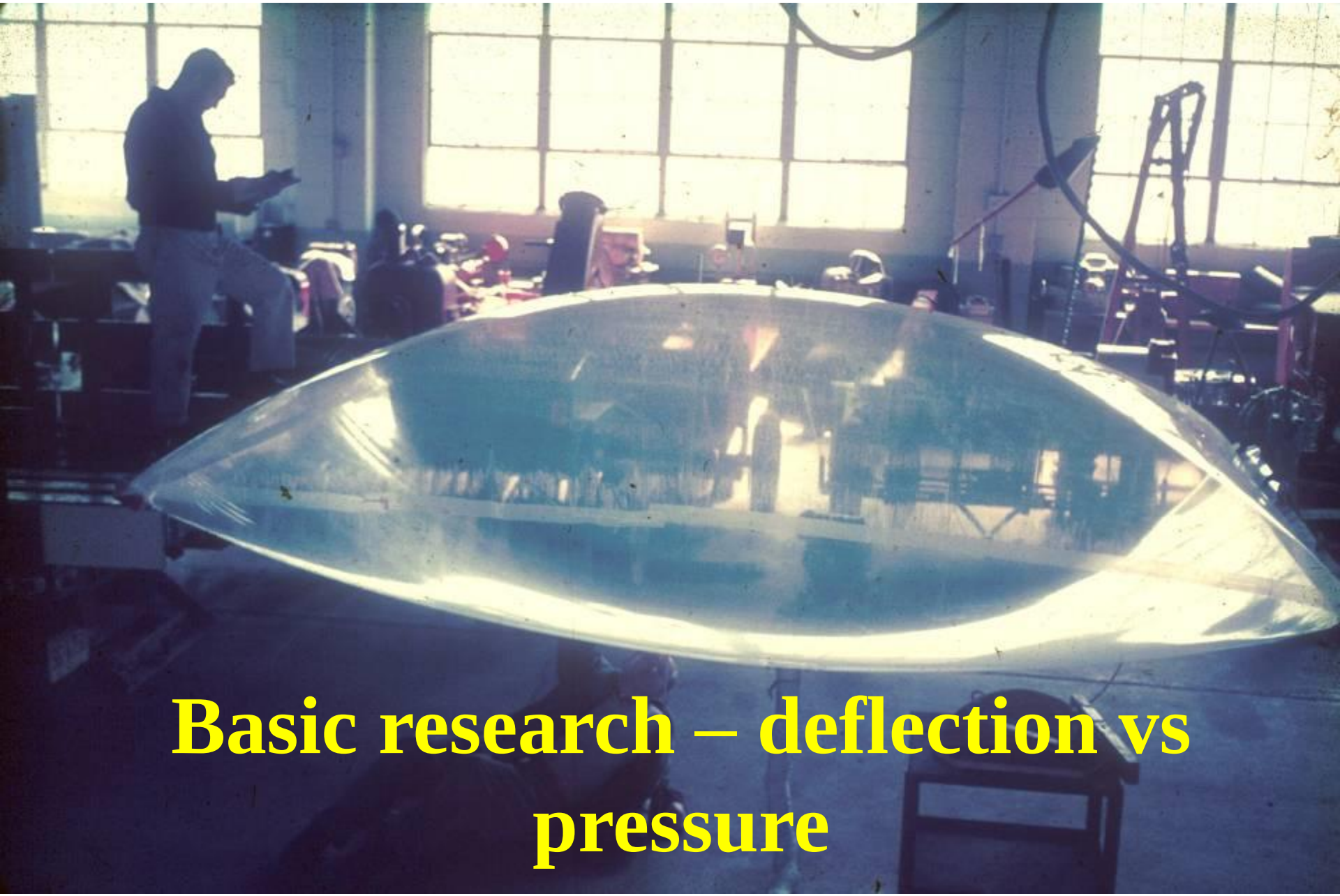
Professors William J. Roberts and David R. Mears

Advantages of Air-Inflated Double Poly

- Low costs
- Easy installation
- Great energy conservation
- Sturdy structure
- Proper light transmission

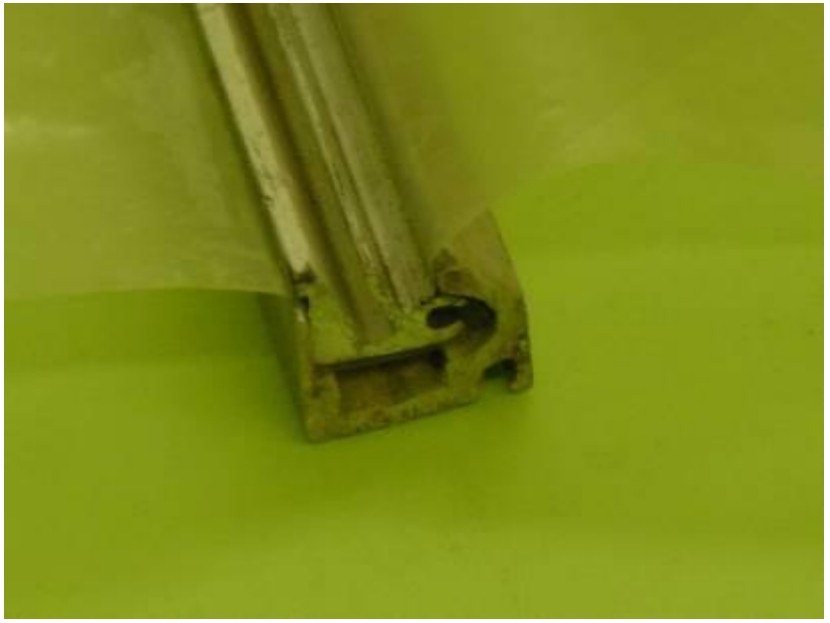
Current Status

- More than 65% of plastic greenhouse in US is air-inflated double Poly
- More than half of the plastic greenhouse in the world is air-inflated double Poly
- Getting more attention in tropical and subtropical regions in some greenhouse for specific applications



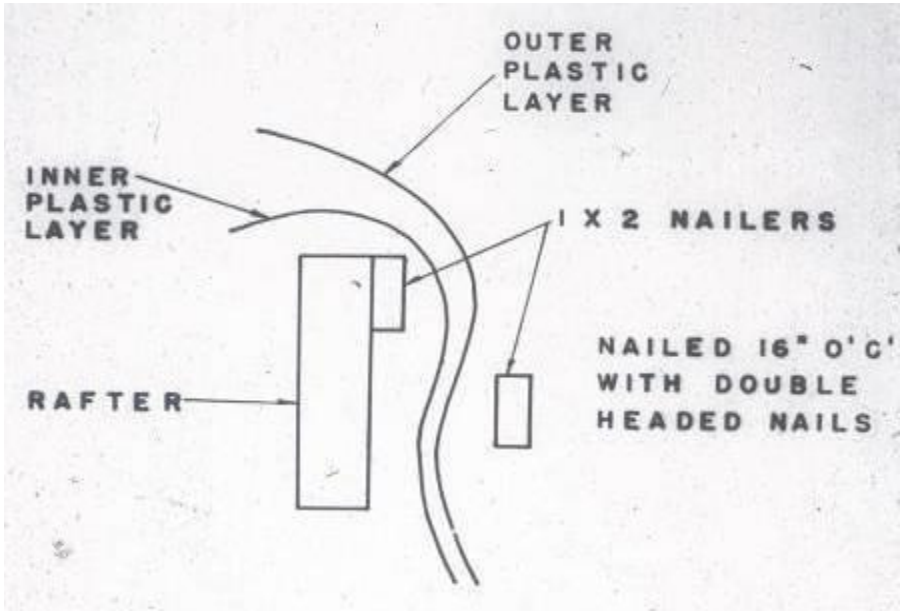
Basic research – deflection vs pressure

First experimental trial

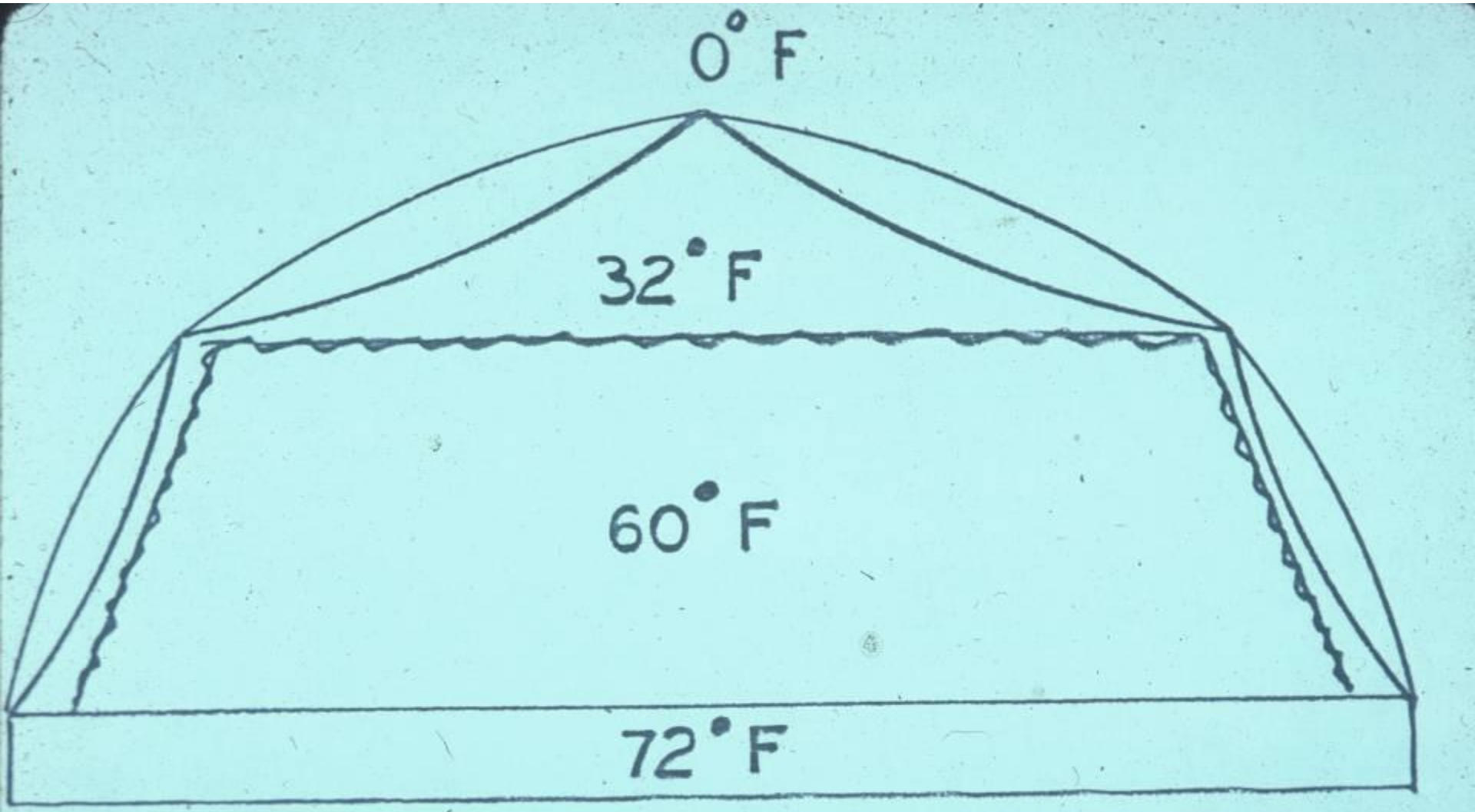


Inflation fan grant $50.00

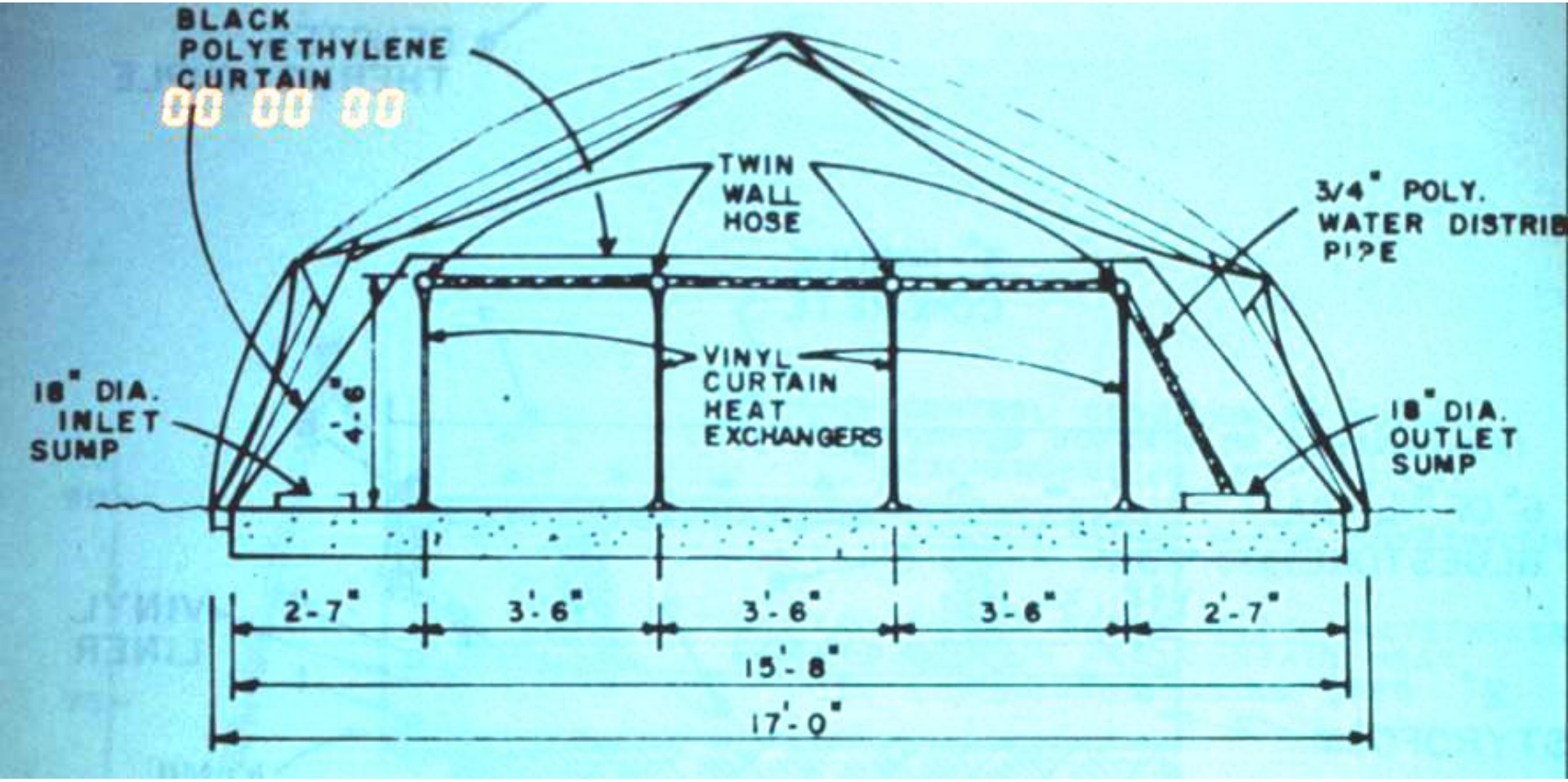
Fasteners evolved from simple wood nailers to engineered extrusions



First greenhouse with double poly



FLOOR HEAT + INSULATING CURTAIN


BLACK
POLYETHYLENE
CURTAIN
TWIN
WALL
HOSE
3/4" POLY.
WATER DISTRIB
PIPE
VINYL
CURTAIN
HEAT
EXCHANGERS
18" DIA.
INLET
SUMP
18" DIA.
OUTLET
SUMP
2'-7"
3'-6"
3'-6"
3'-6"
2'-7"
15'-8"
17'-0"


The 44th Landmark of ASAE

Air-Inflated Double-Layer Polyethylene Greenhouse - 2004

Dedication Year: 2004
Locations: Foran Hall, Plant Biology and Pathology Department, BioTech Center, Rutgers University and next to the first air-inflated double-layer polyethylene greenhouse one mile away from Foran Hall, New Brunswick, NJ

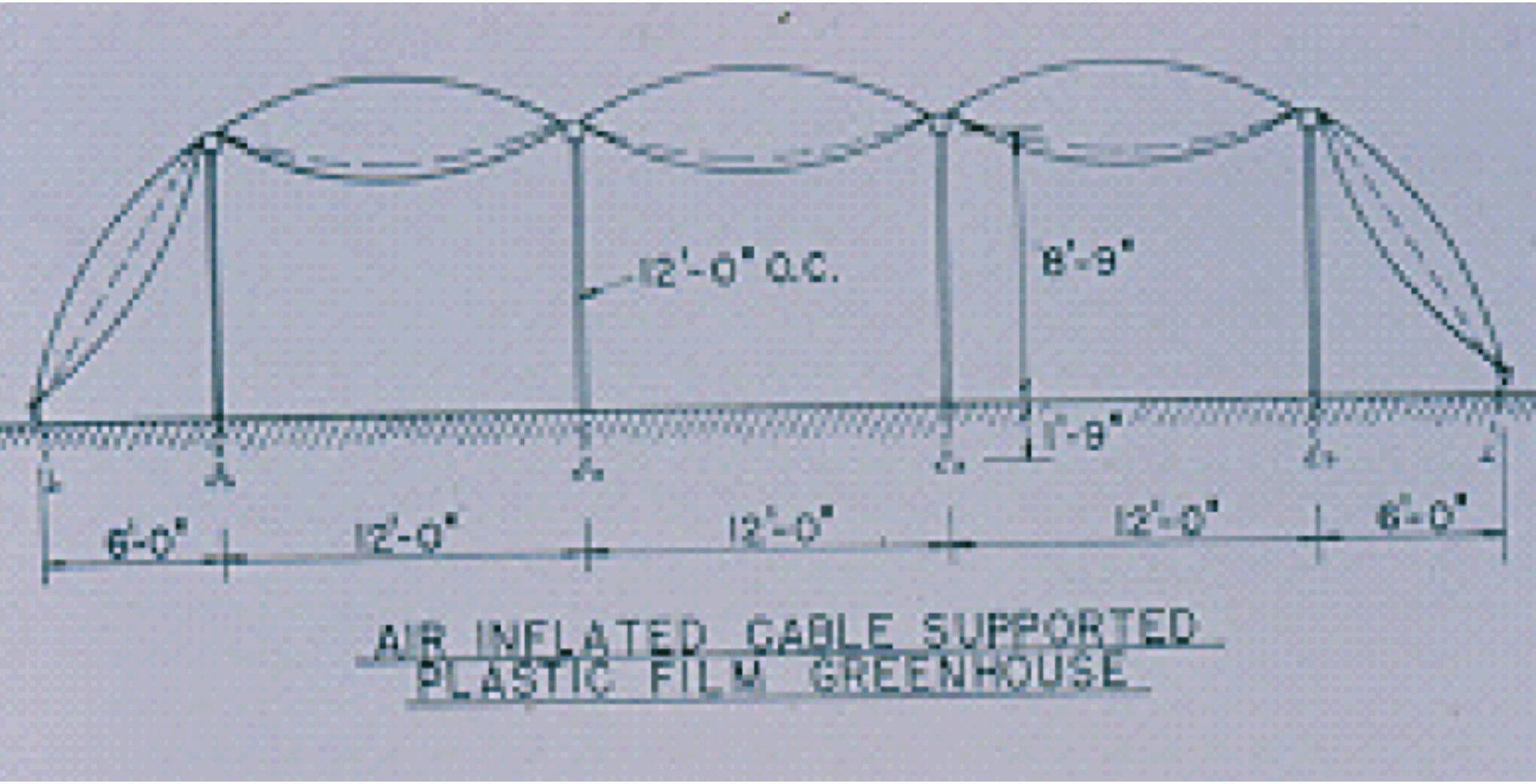
Plaque Wording: A crucial step in the evolution of modern plant agriculture was the development of low-cost, energy-efficient greenhouse structures that provide optimum growing conditions year-round. In 1964, Professor William J. Roberts developed the first air-inflated double-layer polyethylene greenhouse covering system at Cook College, Rutgers University. Air-inflated double-layer polyethylene greenhouse covering systems were quickly and widely adopted throughout the United States and across the world, primarily due to the relatively low installation costs, adequate light transmission, and significant insulating properties.Today, more than half of all the greenhouses worldwide are covered with the air-inflated double-layer polyethylene covering system.

https://www.asabe.org/About-Us/About-ASABE/History/ASABE-Historic-Landmarks/Air-Inflated-Double-Layer-Polyethylene-Greenhouse-2004

First installed in a commercial greenhouse (Kube Pak, Inc.)

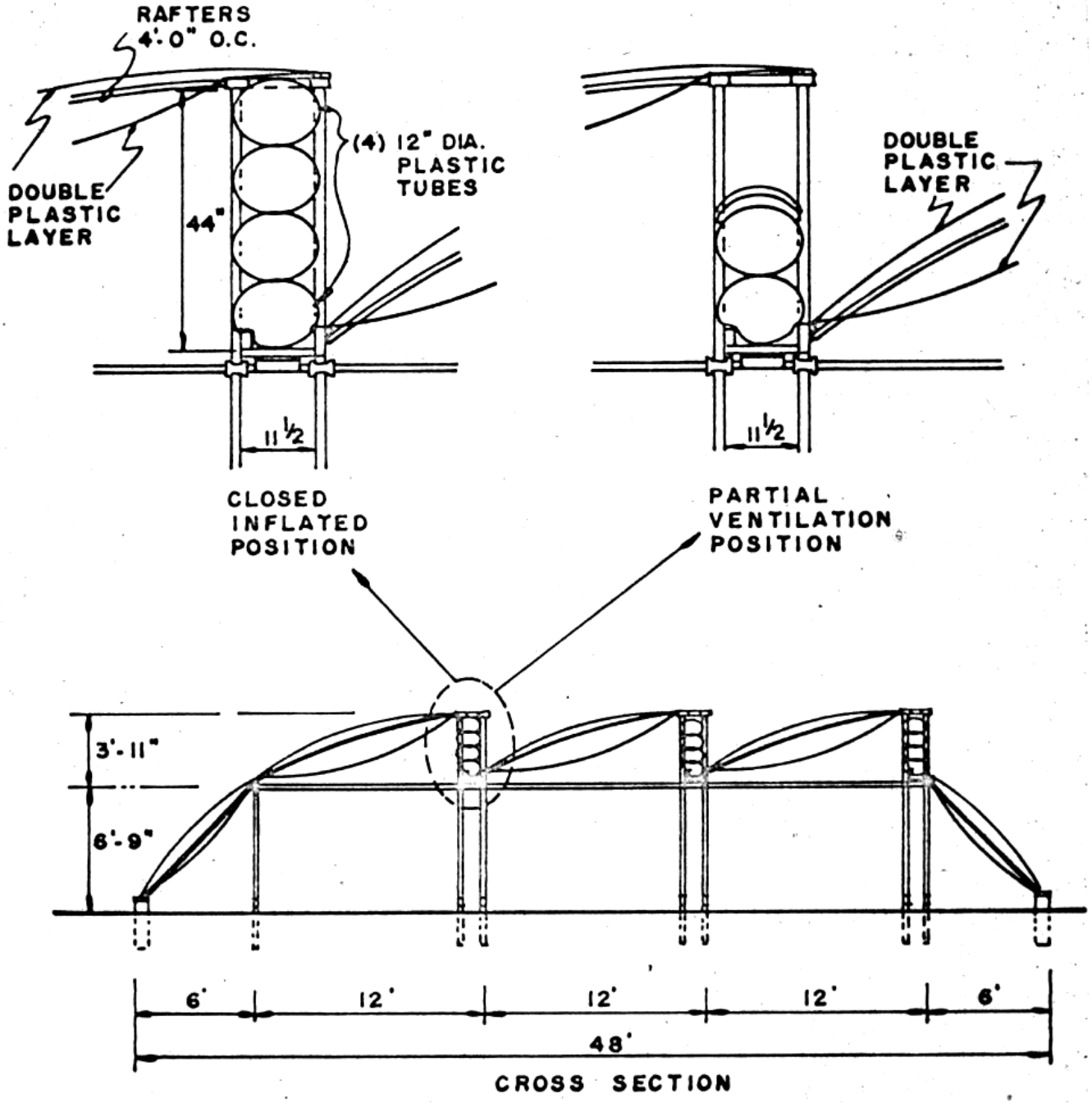
Later development

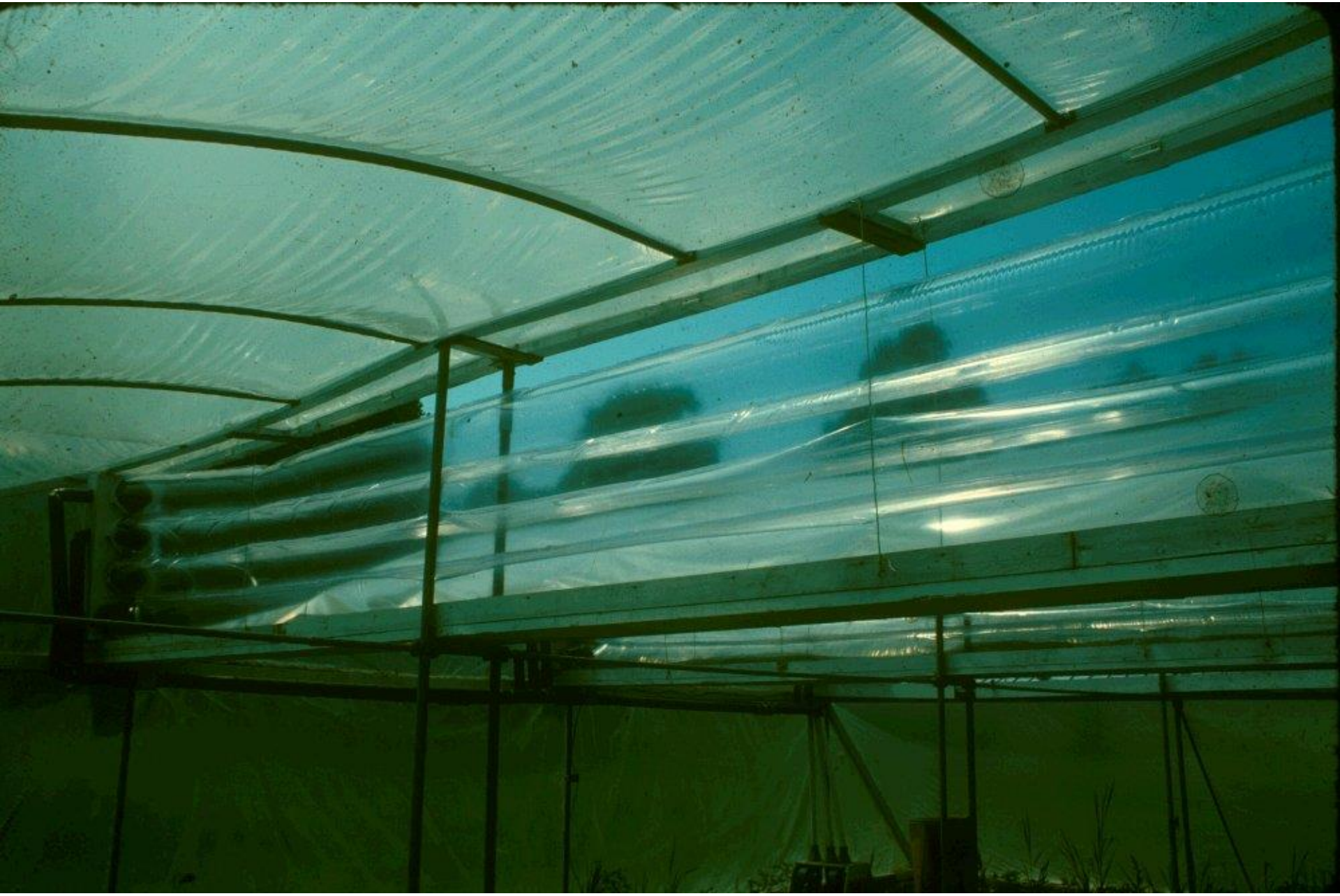
Air-inflated Cable House



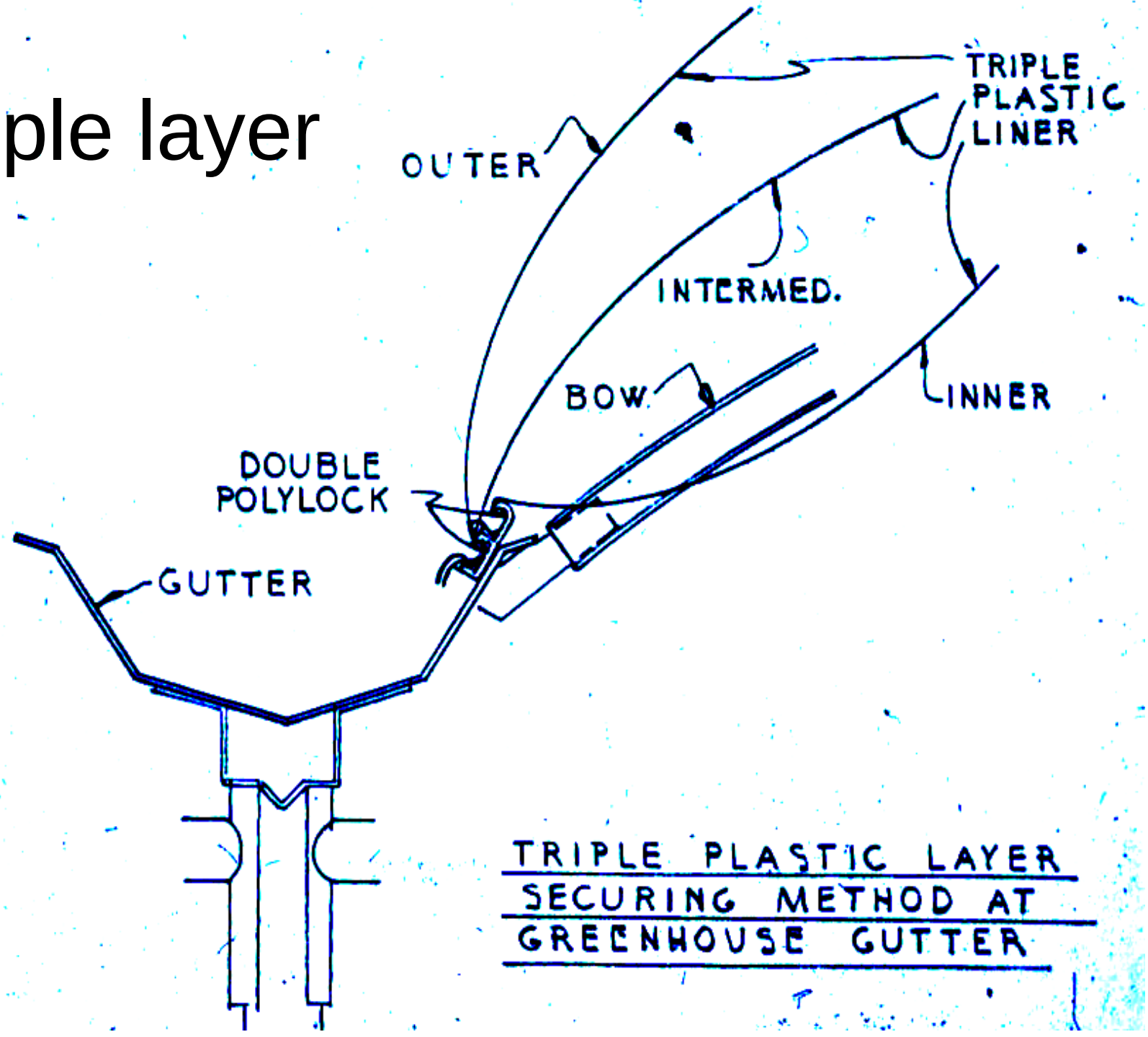
AIR INFLATED CABLE SUPPORTED
PLASTIC FILM GREENHOUSE

Air-inflated side curtain for a sawtooth greenhouse

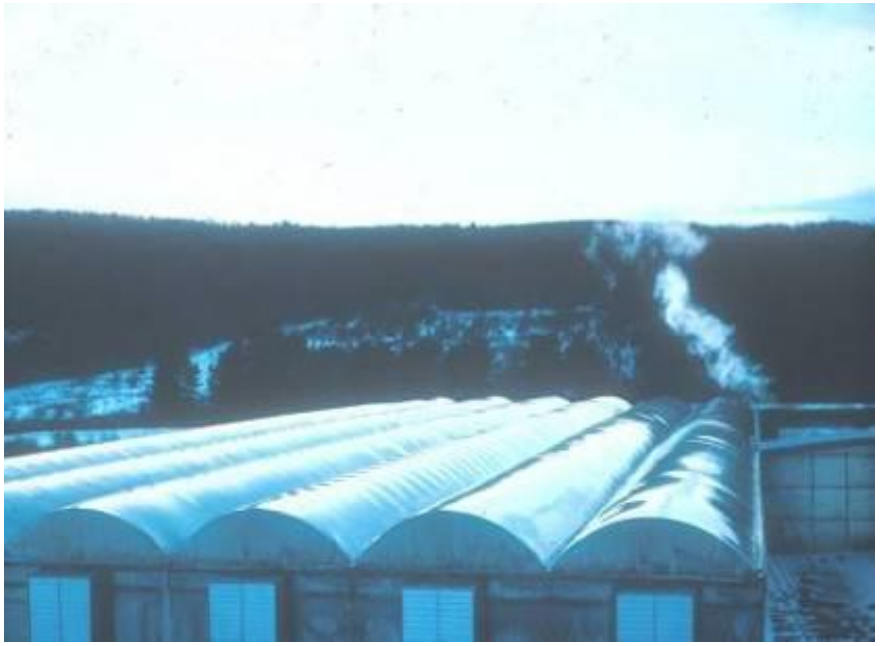

RAFTERS
4'-0" O.C.
DOUBLE
PLASTIC
LAYER
(4) 12" DIA.
PLASTIC
TUBES
44"
11 1/2
CLOSED
INFLATED
POSITION
DOUBLE
PLASTIC
LAYER
11 1/2
PARTIAL
VENTILATION
POSITION
3'-11"
6'-9"
6'
12'
12'
12'
6'
48'
CROSS SECTION



Triple layer



Air-inflated Open top greenhouse



Gutter-connected steel-frame greenhouses with double-poly roofs

Air-inflated Double Poly in Japan

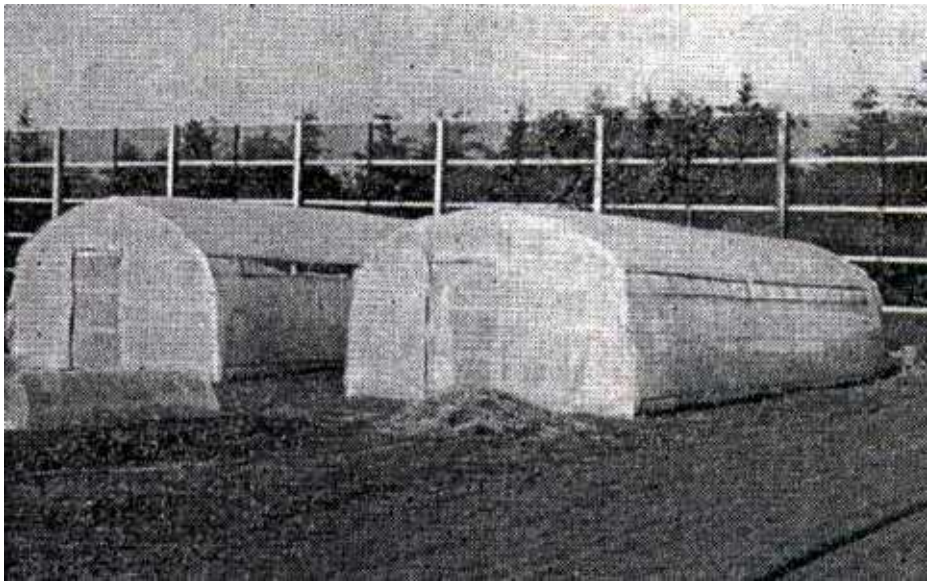
First double-poly in 1978

Prof. Roberts prepares the display of thermal curtain model

Typhoon attacked greenhouses, but no damage on double-poly

2nd generation

Covered with Agron



Okada, M. and Hayashi, I., 1983: Trial construction of an air-inflated greenhouse and its features, Agric. and Hortic., 58(1), 57-60. (in Japanese)

2nd generation in Tsukuba

AgraTech introduced in Tohoku

Current Double-PO Greenhouse

Courtesty Mr. Matsuoka, Kochi Agric Exp Station

Development of a New Air-inflated Greenhouse Design

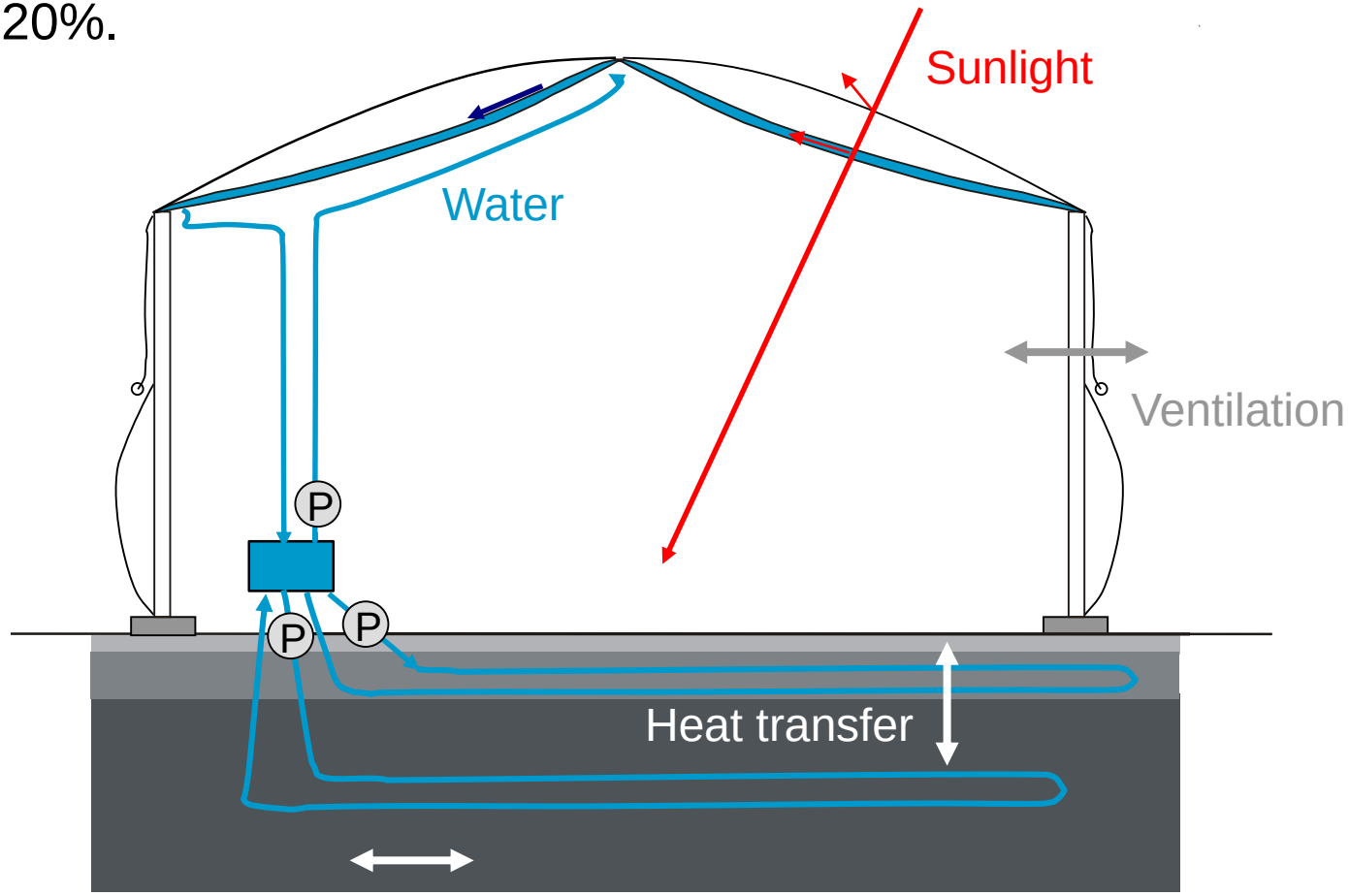
Project leader: Dr. Shimaji, National Institute of Floricultural Sciences, Tsukuba

- Three-layer covering (fluorine film, F-Clean) for insulation
- Collection of solar energy on the roof and storing heated water under the floor
- Large roof ventilators for natural ventilation
- Beam string structure

Prototype greenhouse

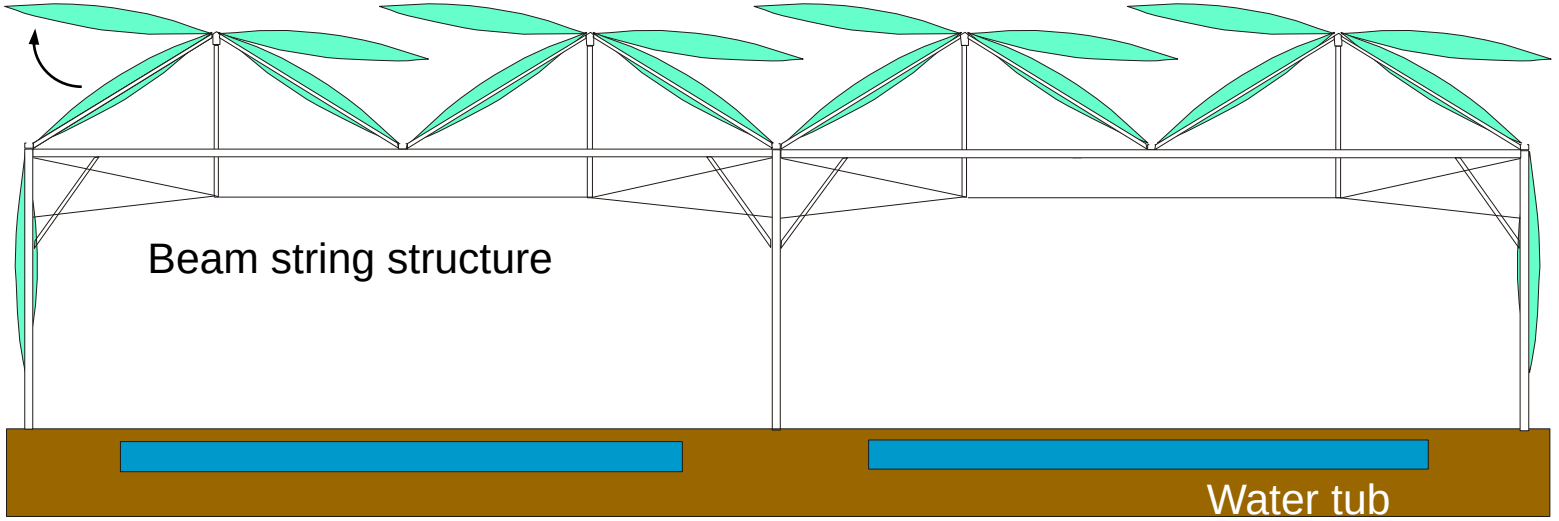
Collecting Solar Energy into Water

- To keep the night temperature difference between inside and outside at 18 °C, additional heating energy was reduced up to 20%.

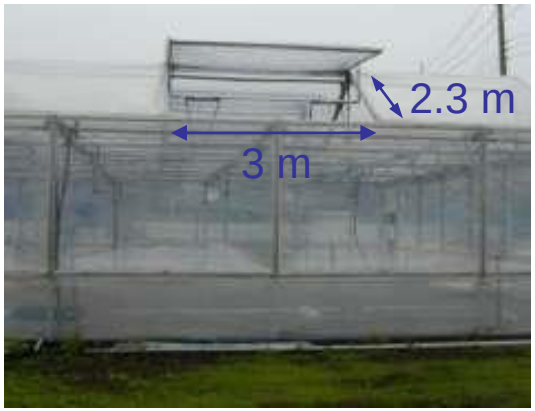


Prototype Greenhouse of New design

Air-inflated roof panel with fluorine film



Panel for roof ventilator



Air-inflated Double Poly in India

1986 India

Air-inflated Double Poly in Taiwan

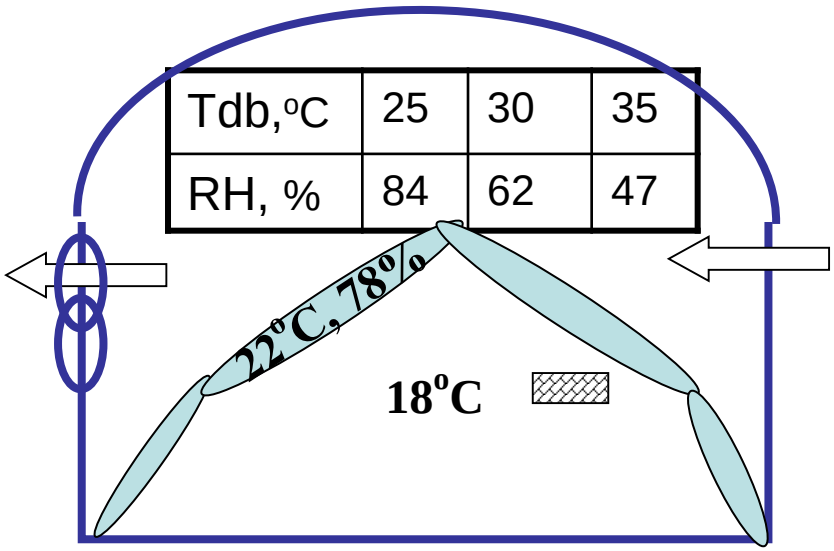
1989 National Taiwan Univ.

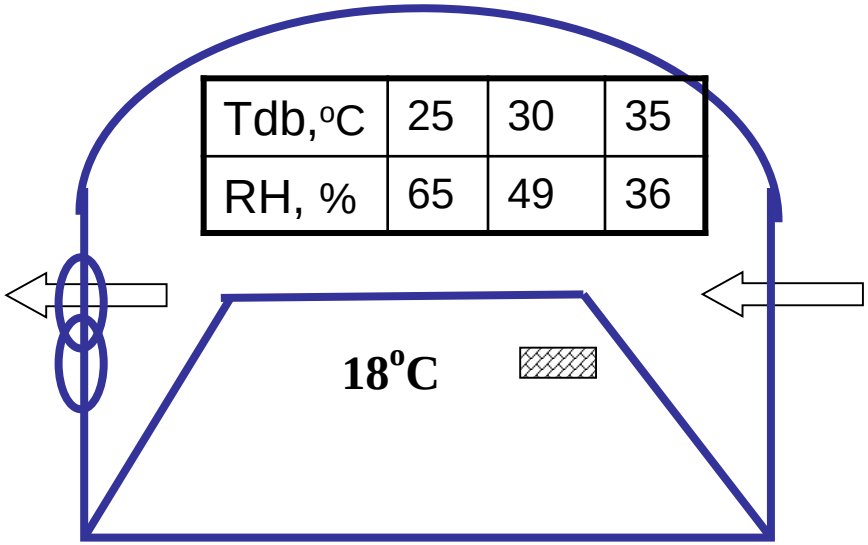
1990 Taichung, Taiwan


No damage on air-inflated double
Poly after one major Typhoon

Phalaenopsis flower forcing required Day/Night Temperature at 25/18 ^{o}C Air conditioner is used in Taiwan

Air-inflated double poly has been used in Flower forcing greenhouse



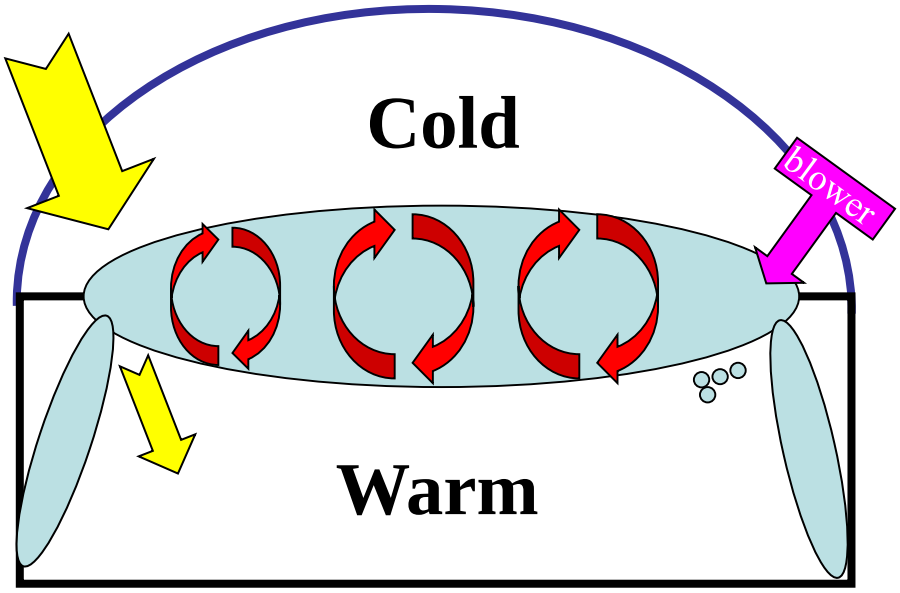


Reduce condensed water and conserved energy

To prevent flower stake emerge, day/night temperature need to keep no less than 28 ^{o}C

- Outdoor T < 28 ^{o}C: 72 ~ 84% in plain area of Taiwan
- Air-Inflated Double Poly can be very helpful in energy conservation
  - as the thermal blanket of an existing greenhouse (glass or poly).
  - as the glazing.

Air-Inflated double Poly can be used in *Phalaenopsis* greenhouse to conserve energy for the prevention of flower stalk emerging



Air-inflated Double Poly in China

1989 China

Greenhouse Manufacturers worldwide

- All Greenhouse manufacturers in US
- At least one Greenhouse manufacturer in France
- At least one Greenhouse manufacturer in Japan

Richel Corp., France

Japan

Landmark Dedication

AIR-INFLATED DOUBLE-LAYER POLYETHYLENE GREENHOUSE

AN HISTORIC LANDMARK OF AGRICULTURAL ENGINEERING

A crucial step in the evolution of modern plant agriculture was the development of low-cost, energy-efficient greenhouse structures that provide optimum growing conditions year-round.

In 1964, Professor William J. Roberts developed the first air-inflated double-layer polyethylene greenhouse covering system at Cook College, Rutgers University.

Air-inflated double-layer polyethylene greenhouse covering systems were quickly and widely adopted throughout the United States and across the world, primarily due to the relatively low installation costs, adequate light transmission, and significant insulating properties. Today, more than half of all the greenhouses worldwide are covered with the air-inflated double-layer polyethylene covering system.

DEDICATED BY THE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
2004

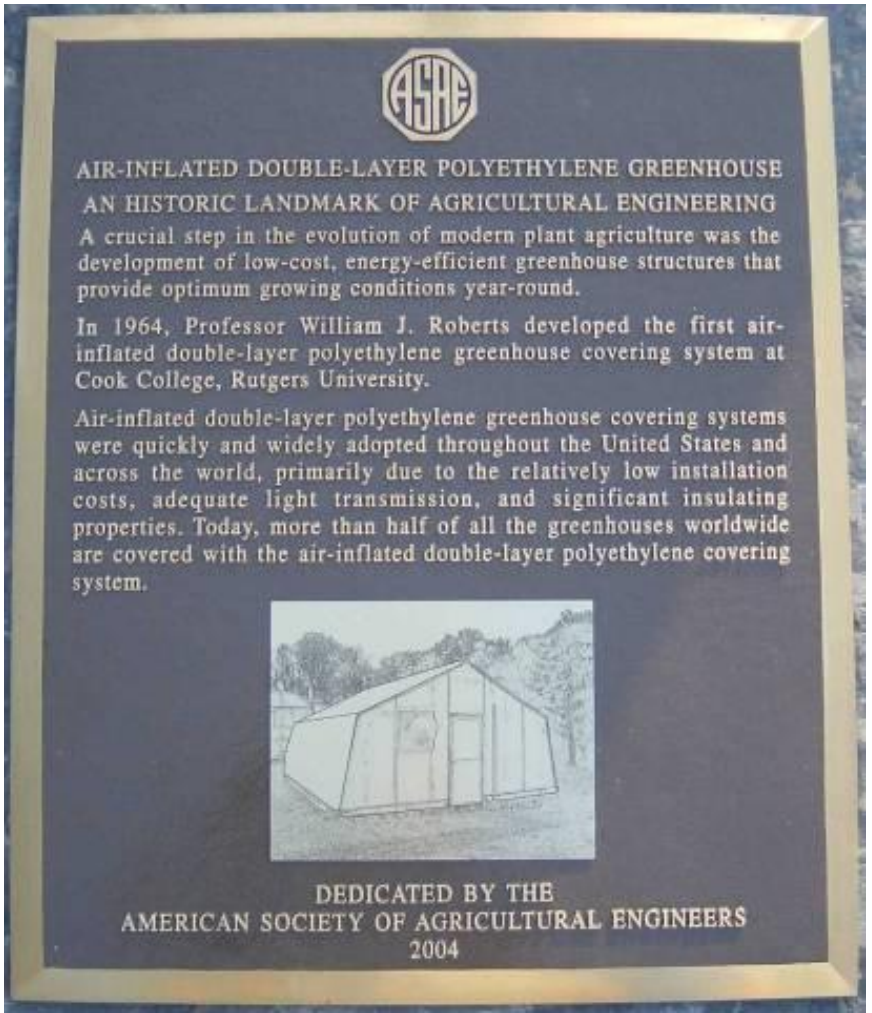
Historic Landmark in Agricultural and Biological Engineering Series:

No. 44

First air-inflated double-layer polyethylene greenhouse

Cook College

Rutgers University 2004



ASABE Former President Robert Gustafson (l) and Bill Roberts at the ASABE Historic Landmark #44 Dedication, Rutgers University, New Brunswick, NJ. June 2004.

Photograph by Alan Goldsmith