

BIRDS AND OTHER CREATURES OF NATURE HAVE BEEN FLYING IN THE EARTH'S ATMOSPHERE FOR MILLIONS OF YEARS. ONLY RECENTLY HAVE PEOPLE LEARNED HOW TO MAKE BIRD-LIKE WINGS AND TO GLIDE AND SOAR LIKE BIRDS; AND THIS ACHIEVEMENT WAS NEITHER QUICK NOR EASY. THEY FIRST MADE KITES, ABOUT 2000 YEARS AGO, AND HAVE BEEN MAKING AND FLYING THEM EVER SINCE. MORE PEOPLE HAVE BEEN INVOLVED WITH KITES THAN WITH ANY OTHER FORM OF FLYING MACHINE, AND THE JAPANESE HAVE PLAYED A LEADING ROLE IN THIS ACTIVITY. I RECENTLY ENJOYED READING AGAIN TAL STREETER'S BOOK "THE ART OF THE JAPANESE KITE" THAT HE GAVE ME SOON AFTER ITS PUBLICATION IN 1974. I ALSO REREAD "KITES: AN HISTORICAL SURVEY" GIVEN TO ME BY ITS AUTHOR, CLIVE HART, WHEN IT WAS PUBLISHED IN 1967. HIS FINAL CHAPTER IS DEVOTED MOSTLY TO GERTRUDE'S AND MY FLEXIBLE KITES. I FELT THAT IN THIS TALK I SHOULD AT LEAST MENTION KITES, THE OLDEST ARTIFICIAL FORM OF FLIGHT AND EVEN TODAY THE MOST POPULAR AS AN ART, A SPORT, AND AS A BRANCH OF AERONAUTICAL TECHNOLOGY.

ABOUT 200 YEARS AGO, BALLOONS WERE INVENTED AND ARE STILL BEING USED FOR MANY PURPOSES INCLUDING SPORT. SOON AFTER PEOPLE STARTED GOING UP IN BALLOONS, THEY STARTED COMING DOWN IN PARACHUTES, WHICH ALSO HAVE MANY USES TODAY. THE ORIGINAL BALLOONS AND PARACHUTES WERE NEARLY SPHERICAL IN SHAPE, BUT PEOPLE SOON LEARNED HOW TO MAKE BALLOONS OF A MORE STREAMLINED SHAPE AND TO ADD ENGINES AND PROPELLERS TO PROVIDE FORWARD SPEED. THESE LIGHTER-THAN-AIR VEHICLES ARE STILL IN USE TODAY. PARACHUTES HAVE REMAINED NEARLY SPHERICAL. SOME WERE INTENTIONALLY BUILT WITH ENOUGH ASYMETRY TO MAKE THEM FALL ON A SLANT RATHER THAN VERTICALLY, AND COULD BE DIRECTIONALLY CONTROLLED, BUT THEIR AERODYNAMIC FORCE WAS MOSTLY DRAG. THESE CONTROLLED PARACHUTES ARE SOMETIMES CONFUSED WITH FLEXIBLE-WINGS (PARAWINGS OR PARAGLIDERS), WHICH WILL BE DISCUSSED LATER, IN WHICH THE AERODYNAMIC LIFT IS MUCH GREATER THAN THE DRAG.

ONE HUNDRED YEARS AGO OTTO LILIENTHAL BEGAN FLYING FOOT-LAUNCHED GLIDERS THAT HE HAD DESIGNED AND BUILT. HE MADE THOUSANDS OF FLIGHTS ON A VARIETY OF GLIDERS UNTIL HIS UNFORTUNATE FATAL ACCIDENT IN 1896. I CONSIDER HIM THE FATHER OF HANG-GLIDING, AND I'M HAPPY TO CELEBRATE THIS 100TH ANNIVERSARY YEAR OF HIS FIRST FLIGHT.

KNOWLEDGE OF LILIENTHAL'S WORK INSPIRED THE WRIGHT BROTHERS TO UNDERTAKE DEVELOPMENT OF SUCCESSFUL GLIDERS, WHICH THEY ALSO FLEW AS KITES, AND, AFTER ADDING ENGINES, AS POWERED AIRPLANES. THEIR FIRST FLIGHTS WERE MADE IN KITTY HAWK, NORTH CAROLINA, A FEW MILES FROM WHERE I LIVE. EACH YEAR ON DECEMBER 17, WE HELP CELEBRATE THE ANNIVERSARY OF THEIR FIRST POWERED FLIGHT. THEIR WORK LED TO THE CONVENTIONAL RIGID AIRCRAFT OF TODAY, BOTH CIVIL AND MILITARY.

I THOUGHT IT MIGHT BE POSSIBLE TO DEVELOP SIMPLER, MORE PRACTICAL, AND LESS EXPENSIVE SMALL AIRCRAFT, ESPECIALLY FOR SPORT OR RECREATIONAL USE. IN 1945 I SUGGESTED SUCH A GOAL FOR RESEARCH BY THE NACA LANGLEY RESEARCH CENTER FOR WHOM I HAD WORKED SINCE 1936. THEY DID NOT WISH TO UNDERTAKE SUCH WORK, BUT SAID I COULD DO IT AT HOME IN MY SPARE TIME.

IN 1946 I ATTENDED A LIGHT AIRCRAFT SYMPOSIUM IN DETROIT, AND SPENT ABOUT A WEEK AT THE PIPER AIRCRAFT FACTORY IN PENNSYLVANIA BEFORE COMING HOME. I CONTINUED TO STUDY THE PROBLEMS OF CREATING "EVERYMAN'S AIRPLANE" AND DISCUSSED THEM WITH OTHERS, INCLUDING MY FRIEND AND NEIGHBOR, JEAN ROCHE, WHO HAD DESIGNED THE ORIGINAL AERONCA AIRPLANE SOME YEARS BEFORE. I ATTENDED TALKS IN MICHIGAN AND VIRGINIA BY BILL STOUT, DESIGNER OF THE FORD TRIMOTOR, WHOSE MOTTO "SIMPLIFICATE AND ADD LIGHTNESS" I HAVE NEVER

FORGOTTEN. IN MAY 1948, WITH MY WIFE GERTRUDE AND OUR THREE CHILDREN, I BEGAN A LONG VACATION AUTO TRIP FROM VIRGINIA TO CALIFORNIA AND BACK DURING WHICH I VISITED 19 AERONAUTICAL ESTABLISHMENTS. AFTER RETURNING HOME EARLY IN JULY 1948, I HAD THE THOUGHT THAT IT MIGHT BE POSSIBLE TO MAKE AN AIRCRAFT WING WITH A PARACHUTE-LIKE STRUCTURE THAT WOULD OPEN AND MAINTAIN ITS SHAPE BY WIND PRESSURE AS A PARACHUTE DOES. WITH GERTRUDE'S HELP, I MADE SMALL MODELS AND TRIED TO FLY THEM AS GLIDERS AND KITES. WE ALSO BOUGHT A 36 INCH FAN AND MADE A WIND TUNNEL IN OUR HOME FOR TESTING THESE "WINGS." BY THE END OF 1948, WE HAD DEVELOPED SUCCESSFUL FLEXIBLE-WINGS AND HAD FLOWN THEM BOTH AS KITES AND AS MODEL GLIDERS, AND APPLIED FOR PATENT NUMBER 2,546,078. WE CONSIDER 1948 THE YEAR OF THE BIRTH OF FLEXIBLE WINGS. ON AUGUST 15 EVERY YEAR WE CELEBRATE THE ANNIVERSARY OF WHAT WE CONSIDER THE FIRST TRULY SUCCESSFUL FLIGHT OF A FLEXIBLE- WING.

I CONTINUED MY EFFORTS TO INITIATE FLEXIBLE-WING RESEARCH AND DEVELOPMENT BY THE NACA LANGLEY RESEARCH CENTER, WHERE I WORKED, AND BY OTHER GOVERNMENT AGENCIES, BUT TO NO AVAIL UNTIL 1958 WHEN NACA BECAME NASA AND FLEXIBLE-WINGS WERE OF INTEREST FOR POSSIBLE RECOVERY OF SPACE FLIGHT VEHICLES. IN THE MEANTIME, GERTRUDE AND I CONTINUED OUR RESEARCH AT HOME, AND DURING THE YEARS 1948 TO 1958 WE DEVELOPED A VARIETY OF FLEXIBLE KITES, SOME OF WHICH WERE MARKETED AND PUBLICIZED. OTHER KITE DESIGNERS AND MANUFACTURERS INTRODUCED OTHER VARIATIONS, AND THE TOTAL EFFECT WAS SOON EVIDENT IN THE ART, SPORT, AND TECHNOLOGY OF KITES IN AMERICA.

BETWEEN 1958 AND 1970 THE U.S. GOVERNMENT, AND CORPORATIONS UNDER CONTRACT, DEVELOPED AND FLEW A VARIETY OF EXPERIMENTAL FLEXIBLE-WING AIRCRAFT AND PUBLISHED THE TEST RESULTS. SOME OF THESE AIRCRAFT WERE ALSO PICTURED AND DESCRIBED IN MAGAZINES AND NEWSPAPERS IN THE U.S.A. AND ABROAD, COMING TO THE ATTENTION OF INDIVIDUALS WHO BUILT A VARIETY OF MANNED FLEXIBLE-WING FLYING MACHINES. GERTRUDE AND I ALSO BUILT SEVERAL MAN-CARRYING ALL-FLEXIBLE GLIDERS (PARAGLIDERS) AT HOME, AND FROM 1967 TO 1974 WE FLEW THEM NEAR OUR HOME IN KITTY HAWK. WE ACHIEVED MANNED FLIGHT BY THREE METHODS - FOOT LAUNCHING FROM HIGH DUNES, TOWING WITH A BOAT, AND AS KITES IN THE WIND OVER THE BEACH.

DURING THESE YEARS, 1967 TO 1974, WHEN WE WERE EXPERIMENTING WITH OUR PARAGLIDERS, WE CORRESPONDED WITH JOHN DICKENSON OF AUSTRALIA AND LEARNED THAT IN 1963 HE HAD SEEN A PICTURE AND STORY OF ONE OF THE EARLY U.S. GOVERNMENT FLEXIBLE-WING AIRCRAFT WITH STIFFENING TUBES AT THE LEADING EDGES AND AT THE KEEL. USING THIS WING DESIGN, HE MADE A HANG GLIDER BY ADDING A TRIANGLE CONTROL FRAME AND PILOT SUSPENSION SYSTEM THAT ARE STILL IN GENERAL USE. HE DEMONSTRATED THESE HANG GLIDERS AT MANY WATER SKI SHOWS BETWEEN 1963 AND 1967, LAUNCHING IN THE SAME WAY AS THE FLAT SKI KITES HAD BEEN LAUNCHED, BUT NOW HE COULD RELEASE THE TOW LINE AND FLY AS A FREE GLIDER, MANEUVERING AND LANDING AT A CHOSEN POINT.

INEVITABLY, OTHER AUSTRALIANS FOLLOWED DICKENSON'S LEAD, NOTABLY BILL MOYES AND BILL BENNETT, WHO BEGAN BUILDING SIMILAR HANG GLIDERS AND FLYING THEM BEHIND TOW BOATS FIRST IN AUSTRALIA AND THEN IN EUROPE AND AMERICA, WHERE THEY AND OTHERS LEFT THE WATER AND BEGAN FOOT LAUNCHING FROM THE SAND DUNES AND HILLS. THE EXCITEMENT AROUSED IN AMERICA BY THIS NEW SPORT IS CAPABLY EXPRESSED BY WOLFGANG LANGEWIESCHE IN "THE FLYINGEST FLYING THERE IS," IN THE FEBRUARY '74 ISSUE OF READER'S DIGEST.

IN JULY 1973 A NATIONAL GLIDING MEET WAS HELD NEAR OUR HOME IN KITTY HAWK, ATTENDED BY 26 PILOTS FROM MANY PARTS OF THE U.S., ESPECIALLY CALIFORNIA. IT HAS BEEN REPEATED ANNUALLY EVER SINCE, AND GERTRUDE AND I HAVE NEVER MISSED ONE. IN JANUARY 1974 I WAS GIVEN MY FIRST COMMERCIALLY BUILT HANG

GLIDER, FOLLOWED BY A LATER MODEL IN 1976 AND AGAIN IN 1978, WHICH I STILL FLY, BUT NOT OFTEN. IN DECEMBER 1974 WE WERE INVITED TO ATTEND THE ORGANIZATIONAL MEETING OF THE SWISS HANG GLIDING ASSOCIATION. MANY PILOTS FROM OTHER COUNTRIES ALSO ATTENDED, INCLUDING ALFIO CARONDI WHOM WE LATER VISITED AT HIS HOME IN ITALY, AND MIKE HARKER WHO OPERATED A HANG GLIDER BUSINESS IN GERMANY AND WHOM WE SAW AGAIN IN 1981 AT CYPRESS GARDENS IN FLORIDA AND IN 1989 IN GERMANY.

IN THE YEARS SINCE 1974, HANG GLIDERS HAVE EVOLVED INTO AIRCRAFT OF MUCH HIGHER PERFORMANCE WHICH ARE ALSO MORE COMPLEX AND EXPENSIVE AND WHICH DEMAND MORE SKILL AND TRAINING BECAUSE OF THEIR ABILITY TO FLY HIGHER, FASTER, AND FARTHER THAN THE EARLIER MODELS. PERHAPS IT IS THIS TREND TOWARDS GREATER SOPHISTICATION THAT HAS OPENED THE DOOR FOR POPULARIZATION OF ALL-FLEXIBLE GLIDERS (PARAGLIDERS) SUCH AS THOSE WE FLEW FROM 1967 UNTIL 1974 AND OF GLIDERS STIFFENED BY RAM-INFLATED TUBES. A MODIFICATION WE HAD PROPOSED IN OUR ORIGINAL PATENT.

THERE IS A GREAT VARIETY OF POSSIBLE DESIGNS BETWEEN THE ALL-FLEXIBLE PARAGLIDERS AND THE NEARLY RIGID HANG GLIDERS OF TODAY. MUCH GOVERNMENT RESEARCH HAS BEEN DONE ON FLEXIBLE-WINGS WITH INFLATED-TUBE STIFFENING. THIS CONCEPT HOLDS PROMISE FOR SPORT AND RECREATIONAL VEHICLES. IF THE INFLATED VOLUME WERE SIGNIFICANT, A LIFTING GAS COULD BE USED, AND WE WOULD HAVE A MARRIAGE OF "WINGS" AND BALLOONS. THIS IDEA HAS ALREADY BEEN TRIED, BUT ADDITIONAL DEVELOPMENT MAY BE WORTHWHILE. HUMAN-POWERED, ENGINE-POWERED, BATTERY-POWERED, AND SOLAR-POWERED PROPELLERS HAVE BEEN ADDED TO GLIDERS. I'M SURE THERE WILL BE FURTHER DEVELOPMENT OF THESE SYSTEMS, SEPARATELY AND IN COMBINATION. FLAPPING WINGS HAVE ALSO BEEN TRIED, AND I THINK THIS FORM OF PROPULSION DESERVES MORE STUDY. IT HAS WORKED WELL FOR OTHER CREATURES FOR A FEW MILLION YEARS. PEOPLE HAVE JUST BEGUN TO FLY WITHIN A LITTLE MORE THAN MY LIFETIME. I'D GLAD TO HAVE BEEN PART OF IT, AND WISH I COULD STAY FOR ANOTHER 50 YEARS TO SEE SOME OF THE GREAT ADVANCES I KNOW WILL COME.

AT THE BEGINNING OF THIS TALK, I SAID THAT KITES WERE THE OLDEST FORM OF ARTIFICIAL FLIGHT. MANY OF THE PIONEERS OF GLIDING AND POWERED FLIGHT TESTED THEIR MODELS AND FULL-SIZED AIRCRAFT AS KITES. IN OUR DEVELOPMENT OF FLEXIBLE WINGS, GERTRUDE AND I FLEW MODELS AND MAN-CARRYING WINGS AS KITES, AS I PREVIOUSLY MENTIONED. HOWEVER, FROM THE EARLY 70'S UNTIL THE LATE 80'S, ALMOST ALL HANG GLIDING WAS FOOT-LAUNCHED FROM HILLS AND MOUNTAINS. SOME TOWING OR KITING WAS CONTINUED AND PERFECTED, AND BECAME INCREASINGLY POPULAR WORLD-WIDE. FOR EXAMPLE, THE "FLY AMERICA" TEAM FLEW HANG GLIDERS FROM CALIFORNIA TO KITTY HAWK, LAUNCHING BY MEANS OF TRUCK TOWING, OR KITING. SOME PEOPLE PREFER FIXED WINCHES AND OTHERS PREFER TOWING BY POWERED AIRCRAFT. ALL OF THESE METHODS CAN BE USED FOR LAUNCHING PARAGLIDERS AND HANG GLIDERS. THUS, IT MAY BE SAID THAT KITING, THE OLDEST FORM OF ARTIFICIAL FLIGHT, IS BECOMING THE MOST POPULAR WAY TO GET PILOTS INTO THE AIR.

WE HAVE BEEN PRIVILEGED TO ATTEND INTERNATIONAL HANG GLIDING MEETS IN SEVERAL COUNTRIES, AND WE FEEL THAT SUCH MEETS BRING PEOPLE OF MANY NATIONS TOGETHER IN FRIENDSHIP, THEREBY HELPING TO BRING WORLD PEACE. IT IS AN HONOR AND A PLEASURE FOR US TO BE HERE WITH YOU ON THIS OCCASION, AND WE THANK YOU FOR YOUR GENEPOUS INVITATION.