POSSIBLE DEVELOPMENT OF GLIDING WORLDWIDE

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WHY NOT GLIDING A LONG TIME AGO?

In the history of technological development some inventions, such as the glider, appear only after a long delay with respect to their technical feasibility.

The modern high performance sailplane incorporates construction methods and materials available only in recent times: synthetic resins (epoxy, acrylic) and fibers (glass, graphite, aromatic polyamides), metal alloys, elastomers, etc. It requires a rather sophisticated technology.

The simple glider devised by Otto Lilienthal (Figure 1) at the end of the last century; however, could have been realized in very ancient times, thousands of years before Christ the Chinese or possibly the peoples of the Andean and Indus Valley civilizations possessed the basic technology and materials required. Probably not the Assyro-Babylonians, but certainly the Egyptians after the 22nd dynasty.

Where suitable materials were not available, high strength wood could have been replaced by bamboo stalks, cotton

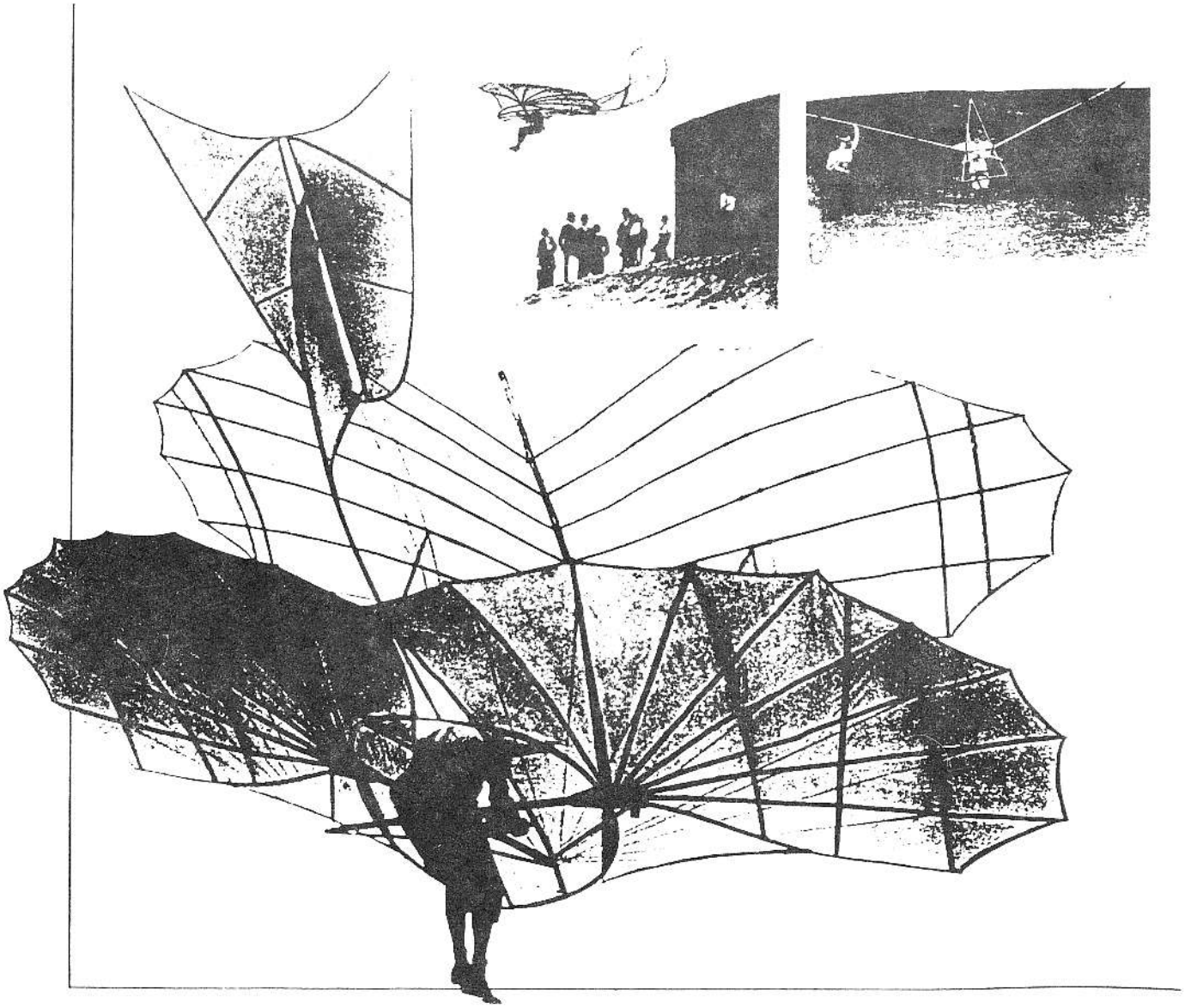

FIGURE 1

fabric by linen (Egypt) or silk (China) metal fittings and joint by sinew and leather string fastenings, tension wires by animal tendons.

In closer historical times, a simple sailplane made of wood was within the technical capability of our ancestors. Laminated wood and plywood were not available, but a braced wing structure with two independent spars, capable of carrying the bending, shear and torsion loads at the same time, was feasible. The well developed bow technology could have been easily applied to a landing skid. Wooden rods made of reeds and hardwood, if not metal pins could have been used for control systems. Some kinds of dope were known to ancient Greeks and Romans; certainly shellac was available.

Hardly the most efficient as a light-weight structure, such a hypothetical glider would have required a wing span and aspect ratio correlated to a wing loading low enough to allow launching. The equivalent of a "bungee-launching" could probably have been realized at those times on the basis of well developed military tension or torsion-catapults or onagers and mangonels or (in medieval times) trebuchets (Figures 2, 3, 4). (Ref. 1, 2).

It is certain that the ancient Romans, who simply improved different types of catapults invented long before by Persians, Phoenicians, Carthaginians and Greeks, were able to launch arrows, pyrotechnical missiles and stones at a distance of more than 400 m (Bibl. 1). This means that their launching devices were able to confer an initial speed of at least

$$vo=\sqrt{d.g}=\sqrt{400x9.81}=\sim 63 \text{ m/ss}$$

to the projectile launched at a 45 degree elevation.

Although stones weighing 10 talents (260 kg.) were used against the Romans during the siege of Syracuse - 213 B.C. -

according to Plutarch, stone weights (W) of 3 to 26 kg. (one talent) were probably in normal use. The energy storage required was, therefore:

$$\frac{v_o^2}{2g}W=200 \times W=600 \text{ to } 5200 \text{ kgm.}$$

For a glider all-up weight W = 200 to 300 kg. and initial velocity v_o = 15 m/s the energy required, neglecting losses, would be:

$$\frac{v_o^2}{2g}W=11.5\ W=2300 \text{ to } 3440 \text{ kgm,}$$

well within the technical capability of those times.

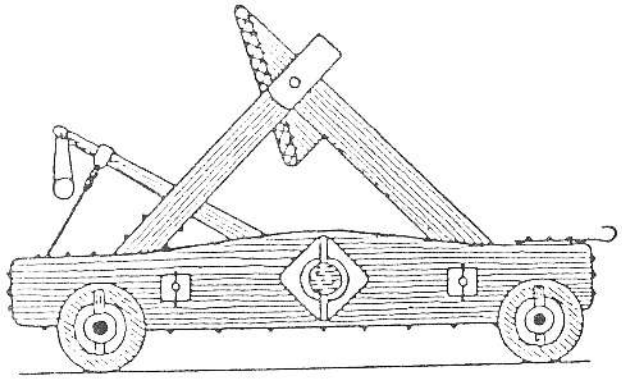

FIGURE 2

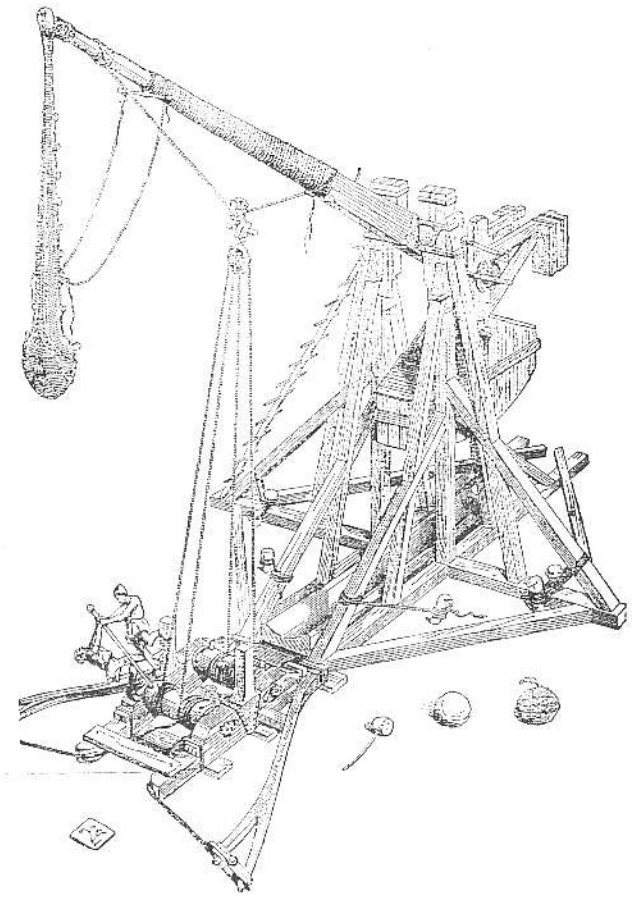

FIGURE 4

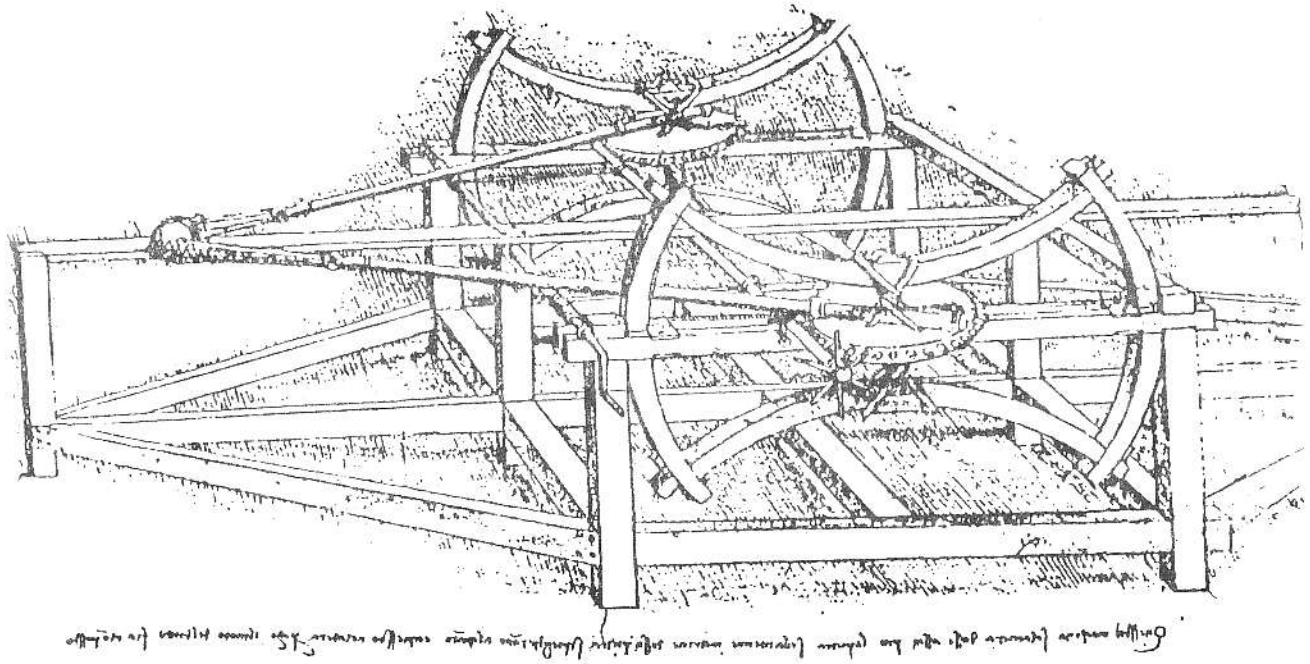

FIGURE 3

The problem of releasing this energy with a comfortable acceleration during the take-off run was also within reach of our colleagues, the engineers of those old times.

What in ancient times prevented the realization of gliding flight, therefore, is not the technological capability to build the machine, which existed, but rather the lack of understanding of those most basic notions of mechanics and aerodynamics that now each of us could summarize in a few written lines, or thoroughly explain in a couple of hours.

"It is a curious fact, but true, that man's age-long observation of birds in flight impeded, rather than accelerated the development of man flight. All human attempts to fly on flapping wings led only to frustration or disaster, for what comes naturally to birds is almost certainly impossible for man to duplicate with his clumsy mechanism" (Ref. 3) and to transfer to another scale of mass and dimension.

Is it not surprising, however, that the only valid bird-flight/man-flight analogue, which appears to be in gliding and soaring, was not fully appraised until the time of Lilienthal?

THE LIMITED EXPANSION OF GLIDING WORLDWIDE

The considerations on the feasibility of a glider, even in very ancient times, make it more surprising that gliding now is ignored in many parts of the world. Although soaring is a fully developed and assimilated art and sport, its actual expansion is limited and the rate of its expansion is very low (Table 1, Fig. 5).

The interest for flying in a personal and recreative way is demonstrated by the outburst of hang gliding about 30 years

TABLE 1

Number of gliders and motorgliders		Population per glider (thousands)		Number of active pilots		Population per pilots (thousands)	
D	7,000	CH	6,500	D	40,000	D	1,500
USA	4,000	D	8,500	USA	15,000	A	1,800
GB	1,800	A	10,000	F	12,000	S	1,900
F	1,500	NZ	10,000	GB	10,000	CH	2,200
PL	1,300	DK	12,500	AUS	4,500	SF	2,500
AUS	1,040	SF	14,000	S	4,500	H	2,800
URSS	1,000	AUS	14,000	A	4,800	NZ	2,900
CH	1,000	S	19,000	NL	3,800	AUS	3,300
A	800	CS	22,000	DDR	3,500	NL	3,800
CS	700	PL	28,500	CS	3,000	DK	4,200
CDH	600	DDR	30,000	CH	3,000	F	4,500
DDR	550	GB	31,000	URSS	2,500	DDR	4,800
S	450	NL	35,000	PL	2,500	CS	5,200
NL	420	F	36,000	DK	2,200	GB	5,500
I	400	N	36,000	YU	2,000	B	8,300
DK	400	CDN	42,000	SF	2,000	H	11,000
SF	350	H	43,000	J	1,500	YU	11,500
NZ	320	BR	48,000	N	1,400	PL	15,000
YU	270	B	50,000	CDN	1,200	USA	16,000
BR	250	USA	59,000	B	1,200	CDN	21,000
H	250	YU	83,000	IRL	1,200	IL	27,000
RA	250	ZA	97,000	NZ	1,100	IRL	29,000
ZA	250	IRL	117,000	I	1,000	ZA	32,000
B	200	RA	120,000	H	1,000	RA	40,000
J	200	IL	133,000	ZA	770	I	57,000
N	110	I	143,000	RA	750	J	81,000
IL	30	URSS	280,000	BR	500	URSS	110,000
IRL	30	J	600,000	IL	150	BR	240,000

A	Austria	F	France	PL	Poland
AUS	Australia	GB	Great Britain	RA	Argentina
B	Belgium	H	Hungary	S	Sweden
BR	Brazil	I	Italy	SF	Finland
CDN	Canada	IL	Israel	URSS	USSR
CH	Switzerland	IRL	Ireland	USA	United States
CS	Czechoslovakia	J	Japan	YU	Yugoslavia
D	West Germany	N	Norway	ZA	South Africa
DDR	East Germany	NL	Netherlands		
DK	Denmark	NZ	New Zealand		

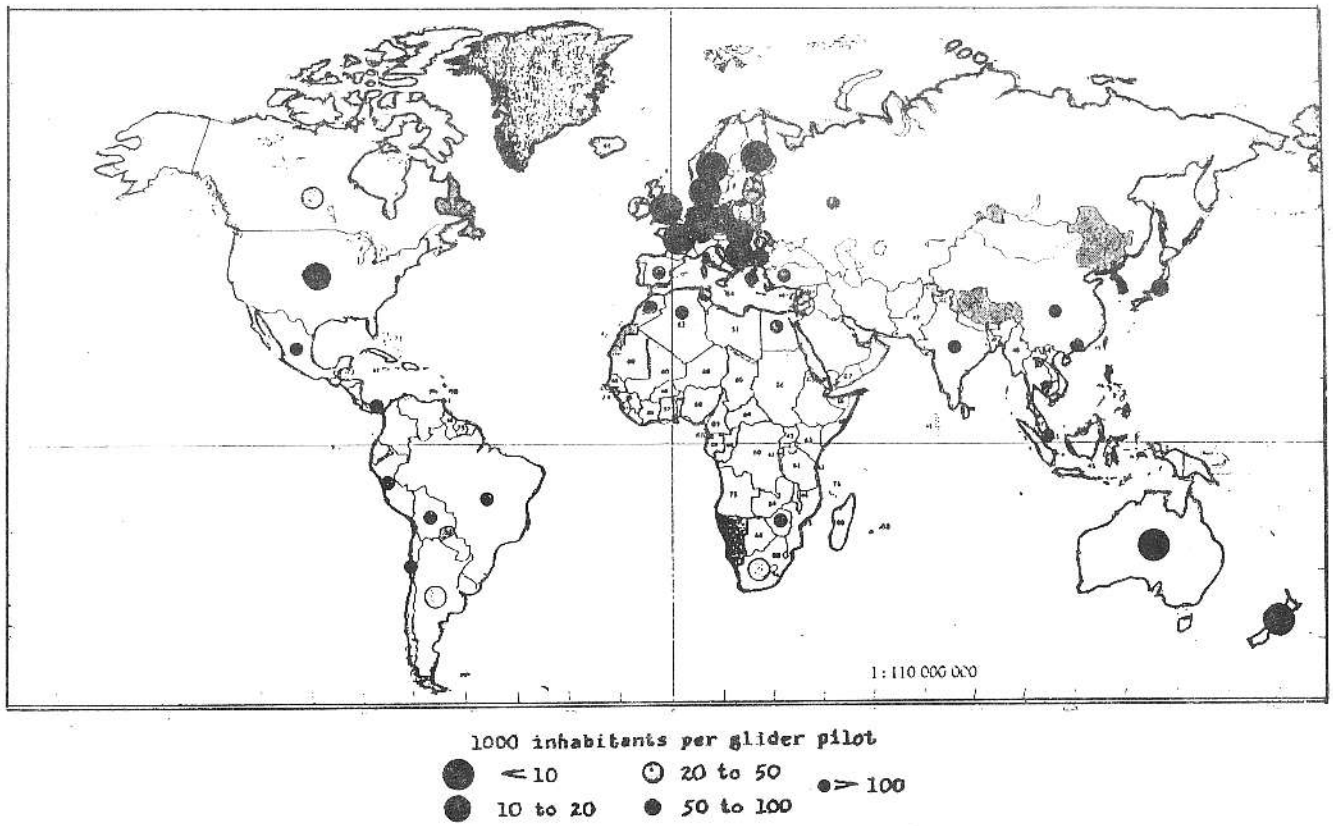

FIGURE 5

ago when, we may say, the Lilienthal's machine was revived. Let us not forget, however, that the safe aerodynamic characteristics of the Rogallo wing was probably a determining factor. The success and rapid development of hang gliding is due to many factors:

- the possibility of individual activity, whereas gliding requires team work for ground support;
- the almost non-existent bureaucratic restraints,
- whereas gliding is heavily burdened with official requirements;
- the low cost of the machine; and
- the low cost of operating the machine.

Of course, the hang glider performance is poor with respect to a conventional glider. Still, the pilots enjoy their flying, their performance has reached levels unthinkable at the beginning, competition flying is fair and successful as the hang gliders, although available in a great variety of types, are comparable with one another in performance.

In recent years the para glider has appeared, derived from the steerable parachute. The gliding performance is much poorer than the hang gliders'. Advantages, however, are the lower cost and the easier ground handling. The rate of development of this new sport at the present moment is even higher than for hang gliding.

The cost of buying, maintaining and operating the machine is undoubtedly one of the main factors in the development of a flying activity, although not the only one. The cost components are listed and compared in Table 2.

A very simple cost/performance relationship was recently suggested by Stanislaw Zientek (Bibl. 4): best glide ratio, $(L/D)_{max}$ as the simplest performance index, versus investment cost. I have made an evaluation of costs, valid for my country and reasonably approximate for EEC countries, and restricted my considerations to Club, Standard and 15-Meter class gliders: the open class gliders would require such an extension of the diagram scale that the para gliders at the other end would almost disappear (Figure 6).

The huge gap between actual gliders and hang gliders is impressive. Nothing is presently produced in the large area of 10 to 34 glide ratio and 10 to 55 thousand DM investment cost.

WHAT CAN BE DONE FOR THE EXPANSION OF GLIDING

Several considerations have induced the International Gliding Commission to attempt the introduction of a new one-design glider class, the "World Class." The development of a low-cost glider with a reasonable performance has been suggested by many since several years (Ref. 5, 6, 7, 8, 9), to meet different needs.

This glider should be suitable for use in clubs or by private owners and for training. Its performance should be good enough to allow the achievement of badges; also good for competition flying. Its construction should be simple enough to allow manufacture by not necessarily highly specialized manufacturers, and possibly also by individuals starting from kits. It is felt altogether that such a glider would help the introduction of gliding in countries where it does not actually exist, and the development of gliding where it is active already.

The history of gliding shows that competitions have always determined the development trends of gliding, having

TABLE 2

COSTS IN 1000 DM	STANDARD CLASS GLIDER	WORLD CLASS GLIDER	HANG GLIDER	PARA GLIDER
investment: - glider	67	34	3	2
- trailer	16	12	-	-
- instruments (basic) + radio	6	5	1	1
- equipment & accessories	2	.7	.3	.2
- parachute	1.5	1.5	1	.7
- registration	1	1	-	-
Total investment:	93.5	54.2	5.3	3.9
1-year operation: - inspection glider & equipment	1	1	.2	.2
- storage	2	-	-	-
- insurance	2	1.2	.7	.5
- launching (No.50)	2	1.2	-	-
- interest on investment (7%)	7	4	.4	.3
Total 1-year operation:	14	7.4	1.3	1.0

an influence on almost every aspect of gliding, and club gliding in particular. Past experience shows that most manufactured gliders have been designed to the specifications of the classes flown in World Gliding Championships.

The "World Class" therefore, would not only give the possibility to hold single-type championships, where all pilots fly the same glider, but would also bring the very beneficial effect of making available a number of low-cost gliders for club use, thereby promoting the expansion of gliding.

The "World Class" glider would, thus, partially fill the gap between actual gliders and hang gliders, the glide ratio presumably ranging from 30 to 35 and the investment cost from 30,000 to 50,000 DM (Figures 10, 11).

The lower part of the gap (glide ratio around 20 and cost around 20,000 DM) would still remain open. There could be a chance for hang gliding, striving for better performance: a difficult task, however. Or there could be some other kind of simple glider.

The "World Class" glider, designed according to technical specifications which have been already agreed upon within IGC, will probably be considerably smaller and lighter than actual Club and Standard Class gliders. Lower size and weight are important factors in reducing the operating costs, as far as storage and launching are concerned.

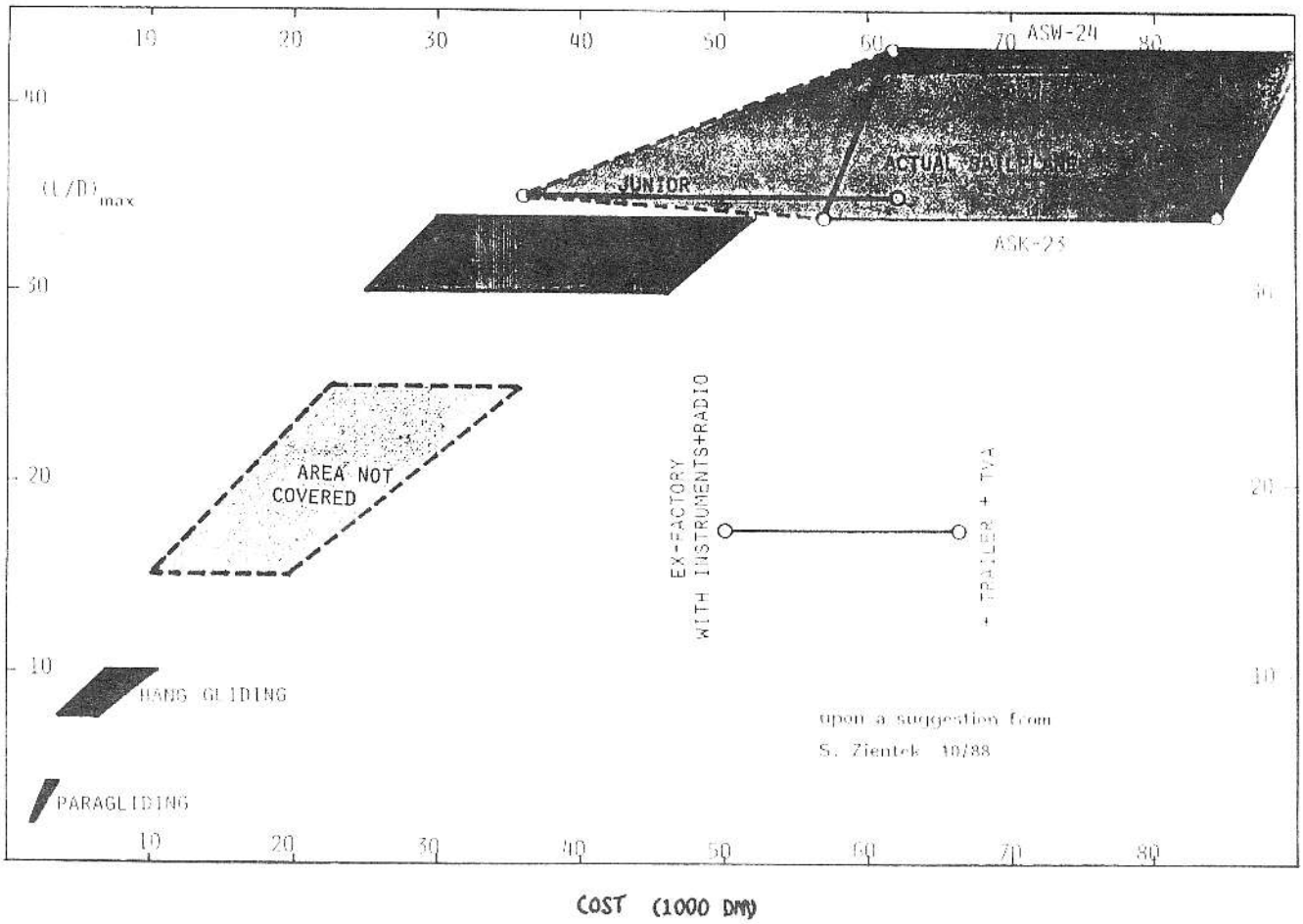

FIGURE 6

Actual gliders with a flying weight of more than 350 and up to 750 kg. require powerful tow planes or winches. A "World Class" glider weighing not more than 250 kg. requires less power for launching: a motorglider could be an adequate tow plane. Old launching means (auto tow, bungee launching) could be revived or modernized (a light catapult?). Launching is a hindrance to the expansion of gliding.

Self-launching is not yet a "popular" solution but considerable progress has been made in the last 20 years. A few years ago a wing span of 15m was considered too small to allow an engine to be carried on board. We see that Standard Class gliders with satisfactory self-launching characteristics are in current production today.

The future will probably offer more efficient and less expensive solutions. This is another promising direction of development, certainly effective for the promotion of gliding.

No action envisaged to promote the expansion of gliding world wide should damage or spoil the basic characteristics of actual gliding, which should be preserved and protected with care. Today's beautiful gliders are the result of an advanced technology, always striving for further progress. The whole activity is a remarkable and well balanced blend of sport, science and technology, rarely found elsewhere. Nobody would ever give up the splendid machines of superb performance and the permanent effort of applied research so successful in improving their performance. We certainly do not want to lose this mark of progress. What is needed is something to be added to the actual structure, in order to complete the range of possibilities to give more people, young people in particular, a chance to try gliding.

If we look at other well established "technical" sports (i.e., where a combination man/machine is in competition) we see, for instance, that between the sailboard and the yacht of the America's Cup a full range of international sailboat classes exist, many of them "one-design," in car racing, a rich range of classes and types of competition fill the wide gap between the go-cart and the Formula 1 car, at different levels of cost and performance.

Although gliding is a sport probably not suitable for masses of people, it must be admitted that the quick and wide development of hang gliding, and ultra light aviation in general, demonstrates that lots of people long for flying. Filling the gap is not likely to be a spontaneous process. Past experience shows that competitions have always determined the development trends of gliding. Gliders are designed and produced within the class definitions issued by the International Gliding Commission of FAI. This Commission has, therefore, the power and consequent responsibility to determine at a large extent, not only the development of competition gliding but the development and expansion of the whole gliding community, including those who fly for a recreational and sporting reward, not for competition, estimated to be not less than 90% of active pilots.

An expansion of gliding world wide, beyond the actual modest limits of 120,000 pilots and 24,000 gliders in about 50 of the 174 world countries, is also a worthy objective for securing the vital air space to our sport and to allow gliding a creditable self-rule (Ref. 10).

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