MISSILES AND AIRCRAFT (PART 3)

Lt C. M. Meyer

The initial stages of the war

Every national force in Europe is weaker than we are. We can conquer in one week the area from Khartoum to Baghdad and Algeria.

Major General Ariel Sharon[1]

While Major General Sharon's words were conveniently forgotten in the initial stages of the war, there were those who maintained that, at the close of the war, the Israelis were on the point of taking Cairo and Damascus. The following factors had been omitted from such reasoning.

1. The Arabs have always fought well in *static* defence, (while being inferior at mobile defence — requiring initiative and a flexible command structure).
2. The Egyptian 1st Army, reserved for the defence of Cairo, unused throughout the extent of the war.
3. The nature of the Syrian countryside *en route* to Damascus — impassable basaltic ridges, ideally suited to defence, that would have to be overpowered one by one — at great cost to the Israelis.
4. The slender manpower reserves of the Israelis were not sufficient for a war of attrition — time favoured the Arabs, not the Israelis.
5. The near certain threat of intervention by the Union of Soviet Sosialistic Russia.

Fig 1: This map gives an idea of the approximate deployment of Egyptian Surface-to-Air missiles.

Egyptian aerial strategy

The Israeli air force showed us all their tricks during 1969-70 . . . They were our teachers and we applied all those lessons in 1973.

Egyptian Air Force commander[2]

Egyptian strategy was negative — to deny the enemy control of air space through an air defence system, rather than to control it by means of Egyptian Air Force aircraft. This had its roots in the destruction of the Egyptian Air Force on the ground in 1967.[3]

Accordingly a strategy was evolved, with the following main points:

1. The placement of Egyptian Air Force aircraft in bombproof pens, situated in widely dispersed airfields safe from aerial attack. These were to be held in reserve.
2. The use of a 'missile unbrella' to protect ground forces from Israeli Air Force attack — particularly when crossing the canal.
3. Using surface-to-surface missiles, (that is *SCUD* in Egypt, and *FROG* in Syria, (*quantum vis*), to bombard Israeli targets — instead of a bomber force. Air-to-surface missiles were also used.

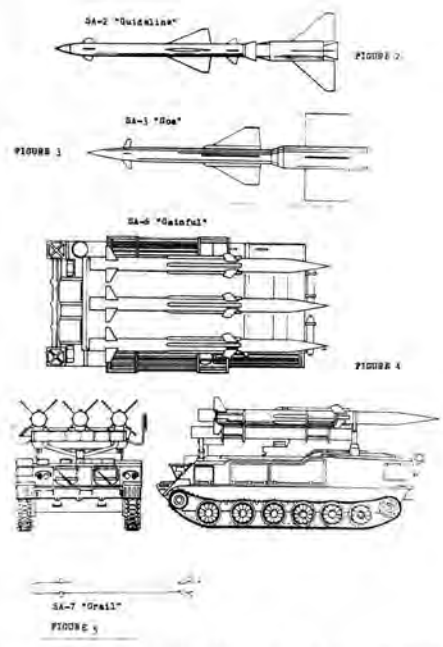


Fig 2: *SA-2* 'Guideline'. Used for high-altitude aerial defence. Requires a static installation.

Fig 3: *SA-3* **'Goa'. Both the** *SA-2* **'Guideline' and the** *SA-3* **'Goa' lack the mobility of the** *SA-6* **'Gainful'.**

Fig 4: *SA-6* **'Gainful'. Plan, rear and side views. Three missiles are carried on a tracked transporter. The missiles are shown pointed to the rear of the transporter — a configuration adopted for travelling. 'Gainful',** *SA-6,* **and** *SAM-6* **are different names for the same missile.**

Fig 5: *SA-7* **'Grail'. Lightweight, man-portable heat-seeking missile. Fig 6 shows a Soviet conscript ready to operate the missile. The target is located through an optical sight, (arrowed 'A' in Figure 6). After the missile has 'locked on' to its target, a light (arrowed 'B') goes on. The missile may then be fired. It will then home automatically on the hot exhaust of an aircraft — without any aid from the person who fired it. 'Guideline', 'Goa', 'Gainful' and 'Grail' are** *NATO* **codenames. 'Strela' and 'Shilka', Russian nicknames for the** *SA-7* **and** *ZSU-23-4* **respectively, are not.** *SA-7, SAM-7,* **'Grail' and 'Strela' all refer to the same missile.**

4. Limited bombing raids by jet strike aircraft on Israeli airfields and military targets — just before the main attack by ground forces.

5. Simultaneous deep penetration helicopter borne commando raids (quantum vis)

The Egyptian Air Defence system

It is particularly remarkable that in the Sixties the Russians had already perfected and applied an integral rocket-ramjet propulsion system, at least 15 years before the rest of the world.

Enrico Po[4]

As both Egypt and Syria had similar air defence systems, and the Egyptian one is better documented, only the Egyptian system will be described. The Egyptian system was made up of *SA-2, SA-3, SA-6* and *SA-7* surface-to-air missiles, and the ZSU-23-4 mobile machine cannon. For most of the medium and higher altitudes covered by the system, enemy aircraft were within range of more than one type of missile. To protect the missiles from low level aircraft attack, *ZSU-23-4* (4 x 23 mm) mobile machine cannon and SA-7 man-portable missiles were deployed.

The *SA-6* and the *ZSU-23-4* were the most significant weapons to emerge from the air defence system. (/) *quantum vis.* The SA-2 (*Guideline*) was used for high-altitude aerial defence. Covering slightly lower altitudes was the *SA-3*, and then the *SA-6*. Covering very low altitudes were the *SA-7* and the *ZSU-23-4*. *Jane's Weapon Systems 1978* gives the ranges of the *SA-2, SA-3* and *SA-6* as follows:

SA-2 (Guideline)	: 40 - 50 km[5]
SA-3 (Goa)	: 25 - 30 km[6]
SA-6 (Gainful)	: 'Maximum[7] : high-altitude possibly 60 km: low altitude probably 30 km.'

FIGURE 7


SA-7 "Grail"
FIGURE 6

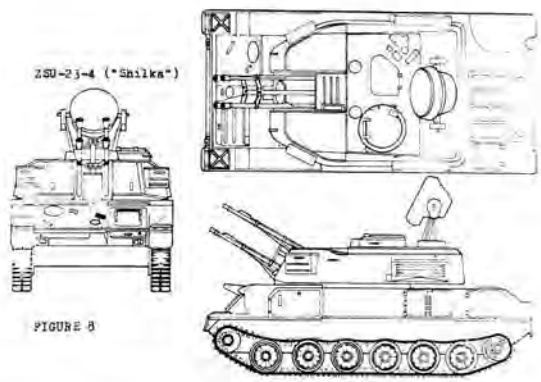


FIGURE 8

Fig 7: Here a *F-4* **'Phantom', (see Figure 11), is attempting to destroy a** *SA-6,* **(also called** *SAM-6),* **launch vehicle. While it would appear from the sketch that the** *SA-6* **vehicle is about to be destroyed by the falling bombs, the steep dive adopted by the Phantom is about to bring it within the range of the** *ZSU-23-4* **'Shilka' Fig 8. Thus, while a steep diving attack may be sufficient to neutralise** *SA-6's,* **the additional presence of** *ZSU-23-4's* **would cause heavy aircraft losses. This explains why the combination of 'Shilkas' and 'Gainfuls' proved so lethal to Israeli aircraft.**

It must be remembered that while the *SA-2* and *SA-3* utilize rocket propulsion, the *SA-6* utilizes a unique rocket ramjet propulsion.[8]

There can be no doubt that, in the initial stages of the war, the *complete* air defence system proved its worth. In examining aircraft loss statistics, (total losses ca 105 for ca 368 Arab aircraft)[9], Viksne analyses the percentages of total combat losses due to different causes. His figures suggest that Israeli aircraft losses from ground-based anti-aircraft defences are comparable, percentage-wise, to Arab losses in air-to-air combat.[10]

In a further analysis of Israeli loss statistics, Viksne gives the following percentages:

*Analysis of Israeli Aircraft Losses**

Small Arms	*37/57*	*ZSU-23-4*			
6%	?	43%	3%	29%	Few

Air/Air	*Own Air Defence*
6%	Several
	SA-7
	SA-6
	SA-2/3

* (as per cent of total combat losses).[11]

While the above figures only give a total of 87%, Viksne says the remaining losses occurred through non-combat causes — 'some 10 to 15 per cent' — and to several unspecified 'other causes'.[12] The precise figures are not important. What is noticeable is that, taken together, Israeli aircraft losses, caused by the *ZSU-23-4* and the *SA-6* accounted for most of the Israeli Air Force losses in the whole war. From Viksne's statistics, 72% of the total Israeli combat losses came from the *ZSU-23-4* and the *SA-6*.

Although Viksne's statistics show the *ZSU-23-4* as downing more Israeli aircraft than the *SA-6*, this does not mean that the *SA-6* is any less effective than the *ZSU-23-4*. As Viksne says: 'Interestingly, the *ZSU-23's* success was principally attributed to the *SA-6* which caused Israeli aircraft to go into a steep evasive dive that brought them into *ZSU-23* range.'[13] The same point is raised in an article in 'Armies and Weapons' on the ZSU-23-4 (quantum vis).[14] The *ZSU-23-4* is described in more detail in a following paragraph.

Two points have emerged from a study of the Egyptian air defence system.

1. *Aerial tactics that may be effective against surface-to-air missile installations and launch vehicles (that is first low level attack, then a steep diving attack), may bring the aircraft involved into the lethal range of the ZSU-23-4, or man-portable surface-to-air missiles (quantum vis).*[15]

2. *It is difficult to assess the individual effectiveness of weapons comprising the Egyptian air defence system as the weapons were used together.*

The ZSU-23-4

There is no doubt that among the many lessons learned from the October War, one of the most important was the revelation of the extraordinary effectiveness of the Soviet ZSU-23-4 Shilka self-propelled close-defence AA gun.

Anon[16]

It is disturbing to note that while the Zenitnaja Samochdnaja Ustanovka, (ZSU), 23-4 made its first appearance in Red Square on the 7th November 1965,[17] the West has no better anti-aircraft gun to offer even today.[18] The Soviet reluctance to discard developed weaponry is evident: The hull, derived from the *PT-76* amphibious tank, is almost identical to that on which the *SA-6* Gainful launch vehicle is based.[19] However, the *ZSU-23-4* launch vehicle is not amphibious.[20] The main armament of the weapon is four 23 mm water-cooled cannon, hence the designation: *ZSU-23-4*.

The weapon is equipped with a *B-76 GUN DISH* radar.[21] Although the 'Insight Team' and Bonds speak of the *ZSU-23-4* 'spewing a thousand shells a minute from each of four barrels',[22] other sources suggest that in actual practice, fifty round bursts are fired at the rate of ca 300 rds/min.[23] The gas-operated guns are mounted close together, and all fire simultaneously,[24] 'thus giving a much greater instantaneous volume of fire than if the four guns fired independently.'[25]

As both *HEI*, (High Explosive Incendiary), and *API*, (Armour Piercing Incendiary), ammunition is used,[26] the 'Shilka' is also a possible threat to lightly armoured *ground* vehicles — Armoured Personnel Carriers and Infantry Combat Vehicles.[27] While only 2 000 rounds are said to be carried,[28] (enough for only thirty seconds' continuous firing time at 4 000 rounds per minute), the presence of support vehicles with additional ammunition is said to ensure a high rate of fire over long periods.[29]

While the *ZSU-23-4* is a formidable weapon, (said to include no less than four separate firing modes[30]), it is not invincible. 'Armies and Weapons' quote two reasons for the *ZSU-23-4's* success against the Israeli aircraft:

1. *The absence of effective Electronic Counter Measures against the* GUN DISH *target acquisition/fire-control radar.*[31]

2. *The presence of missile batteries to take advantage of the 'blind spots' of the missile batteries, Israeli pilots were forced to: (1) approach low or (2) dive bomb from a very steep angle — thus entering the 2,0 km 'lethal' range of the Shilka.*[32] *Later in the war, 'stand-off weapons' were used by the Israelis. (quantum vis) See Note.*[33]

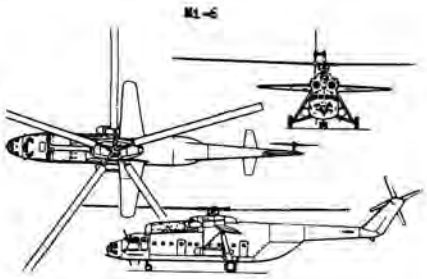


FIGURE 9

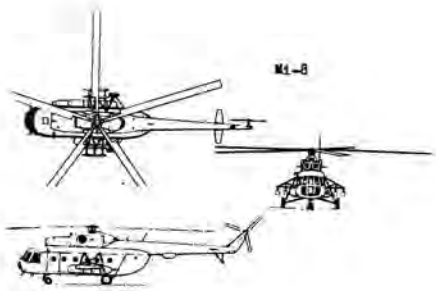


FIGURE 10

Fig 9: Mil *Mi-6* Heavy transport helicopter.

Fig 10: Mil *Mi-8* General utility helicopter, used by the Egyptians in 1973 for attempting commando raids. The Mil *Mi-6* is very much larger than the Mil *Mi-8*.

'Armies and Weapons' state that Electronic Counter Measures have been developed that are capable of neutralizing the *ZSU-23-4*[34]. While the source does state that on a wide front, as in Europe, it would be 'very improbable' that the missile density would be great enough to 'force attacking aircraft onto the self-propelled close AA defence',[35] the firepower of the *ZSU-23-4* should not be underestimated.

Methods suggested by Bahnsen of attacking the *ZSU-23-4* are:

1. *The use of attack helicopters using tube-launched, optically-tracked, wire-guided (TOW) missiles. This type of weapon was purchased by the Israelis after the 1973 war.*[36]
2. *Artillery — if the Shilka is within artillery range.*[37]
3. *The use of 2,75 inch unguided rockets, effective — if they manage to hit the target.*[38]

Helicopter operations and helicopter vulnerability

The importance and significance of tactical (helicopter-borne) landing forces has greatly increased in modern combat.

K. Urtayev[39]

The helicopter was initially used in the Yom Kippur War to transport Egyptian commandos to targets far behind the Israeli frontline. Compare this with one of the Soviet principles of war, as given by Donnelly:

'Attempting simultaneous action upon the ememy to the entire depth of his deployment and upon objectives deep in his rear'[40] While Egyptian commandos suffered heavy losses, those that did reach their targets created more damage than was generally acknowledged.[41]

Fig 11: McDonnell *F-41* 'Phantom', a supersonic jet fighterbomber used by the Israelis. This aircraft was used both to bomb Arab surface-to-air missile sites, (as was the *A-4* 'Skyhawk'), and in air-to-air combat.

After the initial heavy Israeli Air Force losses from *SA-6* missiles, 'spotter' helicopters were used in an attempt to warn Israeli pilots of missile firings. This method, however, had its limitations, as the average time between a SA-6 launch, and its interception of an aircraft was only a few seconds! Helicopters were also used to dump chaff. [42] While the Israelis used helicopters to evacuate caualties from the battle zone the Egyptians pressed Mi-8 helicopters into service later in the war — to drop napalm on the Israeli bridge over th Suez Canal. There is some evidence that Israeli helicopters were vulnerable to the *SA-7* Strela missile.[43] Several suggestions have been advanced as to how helicopter vulnerability may be reduced.[44]

Despite comments that the Israelis were unimpressed with the helicopter as a weapon of war, it would appear that they have decided to invest in missile-firing helicopters.[45]

Ground support

The Air Force . . . is not a sub-contractor for every platoon commander who gets into difficulty.[46]

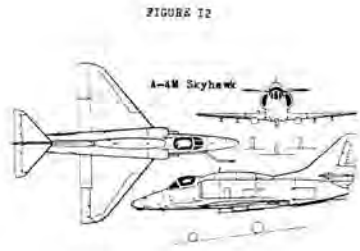
Major General B Peled

The size of the Frontal Aviation Forces, together with their equipment and the command structure under which they operate, are indicative of the importance which the Soviet High Command attaches to close co-operation between air and ground forces in the land battle, and emphasizes the Soviet doctrinal principle of 'all arms co-ordination' as the key to success in modern warfare.

Air Vice-Marshal S. W. R. Menaul[47]

The same principle of 'all-arms co-ordination' was responsible for the initial Egyptian successes and Israeli failures. When the Israelis recognised this principle, and the Arabs forgot it, the tide of the Yom Kippur War changed.[48] Initial Israeli Air Force attacks on surface-to-air missile sites proved disastrous, as disastrous as the first Israeli massed armour counterattack in Sinai.[49]

However, the combined use of air power with ground forces enabled the Israeli forces crossing the Suez canal to gain a foothold on its western bank. It was no longer possible to separate air power from ground forces. Air power had to be used in close co-ordination with ground forces,



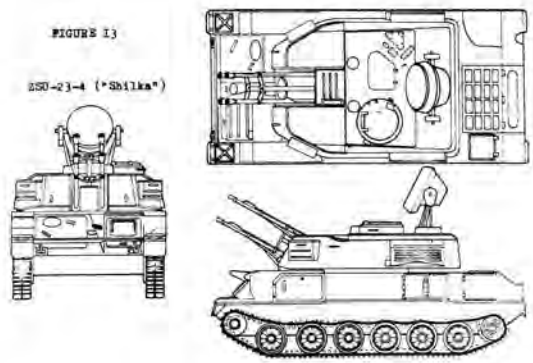


Fig 12: Douglas *A-4M* 'Skyhawk', a lightweight attack bomber.

Fig 13: A *ZSU-23-4* 'Shilka'. Many 'Phantoms' and 'Skyhawks' wereshot down by *ZSU-23-4*'s.

particularly in operations against surface-to-air missile sites and vehicles. Writing on the Israeli Air Force, Zeev Schiff states: 'To successfully confront the latest anti-aircraft weaponry, the plane alone is not enough. The job calls for an inter-arm combat team.'[50]

At times, it may not be possible for air forces to give ground support. Thus, ground forces may be forced back onto greater reliance on their artillery.[51]

This is a reprint of Pointer No 2 on *THE YOM KIPPUR WAR*

FOOT-NOTES

1. The Insight Team. *The Yom Kipper War* (London, 1975), p. 27.

   NOTE: While the Egyptians suffered a crushing defeat in the Six Day War of June 1967, there were several instances of Egyptian garrisons fighting to the last man. Maj Genl Sharon spoke well of the average Egyptian soldier's fighting ability, but scathingly of Egyptian officers.

2. *Aviation Week and Space Technology*, Vol 102, No 26, 30 June 1975 (R. B. Hotz: Egyptian MIG-21 Kills Mirage), p. 14.
3. Pointers, No 2.f.i., 1978 (C. M. Meyer: The Yom Kippur War: Missiles and Aircraft), p. 19.
4. *Armies and Weapons*, Vol 4, No 35, 15 May — 15 June 1977 (INTERINFO SA: SA-6 GAINFUL) p. 62.
5. R. T. Pretty (ed): *Jane's Weapon Systems 1978*, (London, 1978) p. 76.
6. *Ibid*, p. 77.
7. *Ibid*, p. 79.
8. *NOTE*: In the *SA-6*, a solid fuel rocket motor is used to boost the missile to supersonic speed. After the rocket booster has finished burning, the rocket motor is jettisioned. In a normal jet engine, air is first mechanically compressed before being mixed with fuel and detonated. However, once the *SA-6 Gainful is moving at 'critical' speed, the rapid motion of the missile 'rams in' and compresses the air sufficiently to enable air from intakes to be mixed with fuel — and detonated.*
   'It is in successfully establishing the timing of this sequence of events and in controlling the fuel flow, that the greatest difficulties which the Soviet technologists have obviously overcome in brilliant fashion.'
   Armies and Weapons, Vol 4, No 35, 15 May — 15 June 1977, p. 60.
9. *Army Journal*, No 324, May 1976 (J. Viksne: The Yom Kippur War in Retrospect, Part 2 — technology) p. 32.
10. *Ibid*.
11. *Ibid*, p. 33.
12. *Ibid*.
13. *Ibid*.
14. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: SOVIET ZSU-23-4 self propelled AA gun), p. 24.
    NOTE: 'The presence of these weapons (*SA-2, SA-3, SA-6*), obliged the Israeli pilots to keep low, or to attack the missile installations at a very steep angle to take advantage of 'blind' angles, thus falling easy prey to the very high rate of fire of the *ZSU-23-4*.'
15. *Army Journal*, No 307, December 1974 (J. F. Koek: The Middle East Conflict October 1973) p. 8.
16. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA loc cit), p. 24.
17. *Ibid*.
18. *Air Force Magazine*, Vol 59, No 8, August 1976 (Z. Schiff: The Israeli Air Force), p. 38.
19. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), p. 24.
20. *Ibid*.
21. *Ibid*.
22. The Insight Team, *op cit*, p. 184, R. Bonds (ed) *The Soviet War Machine* (London, 1976), p. 189.
23. R. T. Pretty (ed): *Jane's Weapon System, 1977* (London, 1977) p. 92; *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), p. 25.
    NOTE: 'The rate of fire is 3,400 rounds per minute. However it is customary to fire short and long bursts of from 3 - 10 and 50 rounds.'
24. *Marine Corps Gazette*, Vol 62, No 3, March 1978 (M. Kiryukhin (Soviet Colonel)): The ZSU-23-4 is a 4-gunned killer), p. 20. Article translated from Soviet military periodical, *Voyenniye Znaniya* Any information coming from a Russian periodical is however, automatically suspect.
25. *Ibid*, p. 25.
26. R. T. Pretty (ed): *Jane's Weapon Systems 1977* (op cit), pp 92-93.
27. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), pp. 24-25.
28. R. T. Pretty (ed): *Jane's Weapon Systems 1977* (op cit), p. 93.
29. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), p. 20.
31. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), p. 24.
32. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit), p. 24; *US Army Aviation Digest*, Vol 23 No 11, November 1977, (J. C. Bahnsen: How to kill a ZSU) p. 22.
    NOTE: 'At range less than 2 000 metres, the lethality of the *ZSU* is extremely high. The Shilka's effectiveness 'falls off sharply beyond 2 500 metres.'
33. *Ibid*, p. 22.
34. *Armies and Weapons*, Vol 4, No 22, March 1976 INTERINFO SA loc cit), p. 24.
    NOTE: The effectiveness of the ZSU-23-4 is given as falling off sharply beyond 2 500 m.
35. *Armies and Weapons*, Vol 4, No 22, March 1976 (INTERINFO SA: loc cit).
36. *Air Force Magazine*, Vol 59, No 8, Aug 1976 (Z. Schiff: loc cit) p. 38; US Army Aviation Digest Nov 1977 (J. C. Bahnsen: loc cit), p. 23.
37. *Ibid*, p. 25.
38. *Ibid*.
39. *Military Review*, Vol 55, No 10, October 1975 (Quote from soviet military journal, used by G. H. Turbiville: A Soviet view of heliborne assault operations), p. 5.
40. R. Bonds (ed): *op cit*, p. 168.
41. *Aviation Week and Space Technology*, Vol 103, No 1, 7 July 1975 (R. Hotz: Offense, Defense Tested in 1973 War) pp. 16-17.
42. *Army Journal*, No 324, May 1976 (J. Viksne: loc cit), p. 20.
43. *International Defense Review*, Vol 10, No 4, Aug 1977 (P. Borgart: The Vulnerability of the Manned Airborne Weapon System, Part 3: Influence on Tactics and Strategy), p. 1064.
44. *NOTE: On reducing helicopter vulnerability*
    1. *Good camouflage and a small helicopter profile.*
    2. *Beware of radar detection, (by doppler shift), of main rotor blades. This gives a good signature on a Moving Target Indicator, (MTI), possessed by the ZSU-23-4.*
    3. *Infra-red suppression measures: direct the exhaust gases upwards*, and a system warning the pilot that he is under attack by Infra-red head seeking missiles, coupled with IR flares.
    4. Keep the light-reflecting glazed areas on a helicopter as small as possible.

    Royal Air Force Quarterly, Vol 17 No 1, Spring 1977 (A. E. Ryle: The Future of the helicoper as an antiarmour weapon system (Part 2), pp. 47-48; *International Defense Review*, Vol 10 No 4, August 1977 (P. Borgart: loc cit), pp. 669-670; *International Defense Review*, Vol 11 No 1, 1978 (G. S. Sundaram: Helicopters in Electronic Warfare), p. 64.
    NOTE: An interesting new use of helicopters is also said to have emerged from the Yom Kippur War — helicopters against ships. Helicopters armed with air-to-surface missiles, were sent 'skimming slowly over the surface of the water so as to give (enemy radar) the impression that there were only patrol boats there.'
    Reacting to this supposed threat, Egyptian vessels would then encouter a joint Israeli naval air task force, that is said to have obtained 'such effective and surprising results as can well be imagined.'
    Aviation and Marine, Vol 4 No 33, Jan 1977 (R. Cichero: Egyptian Air Force), p. 54.
45. *Air Force Magazine*, Aug 1976 (Z. Schiff: loc cit), p.38; *Army*, Vol 25 No 6, June 1975 (R. Cohen: Israel rebuilds her army) p. 25.
46. Major General B. Peled, Commanding General of the Israeli Air Force.
47. R. Bonds (ed), *op cit*, p. 47.
48. *The British Army Review*, No 48, Dec 1974 (J. Weller: Combined Arms Teams — recent Middle East Experience), p. 52.
49. *Pointers*, No 2 e ii, 1978, (C. Meyer: Tanks and Missiles), p. 5.
50. *Air Force Magazine*, Aug 1976 (Z. Schiff: loc cit), p. 38.
51. *Journal of the Royal Artillery*, Vol 102 No 1, March 1975 (T. L. Morony, OBE: Artillery support in the Yom Kippur War), p. 12.