V/1. Valdiya, K.S., 1980. The two intracrustal boundary thrusts of the Himalaya. Tectonophysics 66, 323-348.

The series of four different, steeply inclined thrusts which sharply sever the youthful autochthonous Cenozoic sedimentary zone, including the Siwalik, from the mature old Lesser Himalayan subprovince is collectively known as the Main Boundary Thrust (MBT). In the proximity of this trust in northwestern and eastern sectors, the parautochtonous Lesser Himalayan sedimentary formations are pushed up and their narrow frontal parts split into imbricate sheets with attendant repetition and inversion of lithostratigraphic units. The superficially steeper thrust plane seems to flatten out at depth. The MBT is tectonically and seismically very active at the present time.
The Main Central Thrust (MCT), inclined 30° to 45° northwards, constitutes the real boundary between the Lesser and Great Himalaya. Marking an abrubt change in the style and orientation of structures and in the grade of metamorphism from lower amphibolitefacies of the Lesser Himalayan to higher metamorphic facies of the Great Himalayan, the redefined Main Central Thrust lies at a higher level as that originally recognized by A. Heim and A. Gansser. They had recognized this thrust as the contact of the mesozonal metamorphics against the underlying sedimentaries or epimetamorphics. It has now been redesignated as the Munsiari Thrust in Kumaun. It extends northwest in Himachal as the Jutogh Thrust and farther in Kashmir as the Panjal Thrust. In the eastern Himalaya the equivalents of the Munsiari Thrust are known as the Paro Thrust and the Bomdila Thrust. The upper thrust surface in Nepal is recognized as the Main Central Thrust by French and Japanese workers. The easterly extension of the MCT is known as the Khumbu Thrust in eastern Nepal, the Darjeeling Thrust in the Darjeeling-Sikkim region, the Thimpu Thrust in Bhutan and the Sela Thrust in western Arunachal. Significantly, hot springs occur in close proximity to this thrust in Kumaun, Nepal and Bhutan. There are reasons to believe that movement is taking place along the MCT, although seismically it is less active than the MBT.
Key words: Tectonics, MCT, MBT, Himalaya.

V/2. Valdiya, K.S., 1983. Tectonic sections of Himalayan granites. In: Shams, F.A. (ed.), Granites of Himalayas Karakorum and Hindu Kush. Institute of Geology, Punjab University, 39-54.

Key words: Tectonics, granites, Himalaya.

V/3. Valdiya, K.S., 1984. Evolution of the Himalaya. Tectonophysics 105, 229-248.

The compression and attendant deformation of a thick and vast sedimentary prism formed since Early Riphean times on the northern continental margin of the Indian craton gave rise to the Himalaya mountains as a result of convergence and collision of the Indian and Asian plates. The oceanic trench-sediments, tectonically implanted with sea-floor material and intimately associated with calc-alkaline volcanics in the narrow Sindhu-Tsangpo belt extending from Kohistan through Dras, Leh, Darchen (Mansarovar) to Shigatse and beyond, represent the subduction-island arc complex which developed south of the dynamic southern margin of the Asian continent and was welded to the colliding Indian plate during the late Eocene to Oligocene period. This complex is fringed to the north by a wide zone of Andean-type granitic bodies. The evolution of the Himalayan orogen is closely connected with the development of the present-day Andaman-Nicobar-Indonesia island arc-subduction system in the southeast and the Makran Ranges-Oman Trench in the southwest.
The evolution of the Himalaya was accomplished in four major phases of tectonic upheaval during the late Cretaceous to Palaeocene (Karakoram phase), late Eocene to Oligocene (Malla Johar phase), middle Miocene to Pontian (Sirmurian phase), and late Pliocene to middle Pleistocene (Siwalik phase). While the Karakoram phase marks the convergence of continents and the Malla Johar phase represents the collision and subduction, it was during the Sirmurian upheaval that the main tectonic features developed and the Himalaya acquired its distinctive structural complexion
Key words: Tectonics, Himalayan evolution, Kohistan-Dras arc.

V/4. Valiullah, M. & Ghanchi, S., 1962. The beryl resources of Pakistan. The Geologists, Geological Society, Karachi University 1, 6-8.

Key words: Economic geology, Beryl.

V/5. Vandercammen, A., 1965. Les Spiriferidae de Shogran et Kuragh (Chitral). In: Italian Expeditions to the Karakorum (K2) and Hindu Kush, (A. Desio leader), Scientific Reports IV (1), 67-75 Paleontology-Zoology-Botany. Brill, Leiden.

This paper describes Devonian Spiriferidae from Shogran and Kuragh in Chitral.
Key words: Palaeontology, Italian expedition, Chitral.

V/6. Van Voltan, R., 1962. Magnesite in Pakistan. Proceedings, CENTO Symposium on Industrial Rocks and Minerals, Lahore, 211-215.

Key words: Magnesite, economic geology, Pakistan.

V/7. Venables, S., 1986. Painted Mountains. Hodder and Stoughton, London, 239p.

This is a mountaineering travelogue of the author. The author is a mountaineer and has published several books which describe his travel experience. This, and the following two accounts describe his journey to the specific areas.
Key words: Mountaineering.

V/8. Venables, S., 1986. Siachen sojourn. Mountain 107, 28-33.

This is a description of visit to the Siachen.
Key words: Tourism, Siachen journey.

V/9. Venables, S., 1988. Karakoram odyssey. Mountain 119, 26-31.

The author gives a description of his wanderings in the Karakoram ranges.
Key words: Tourism, Karakoram, Travelogue.

V/10. Verchere, A.M., 1865. Notes to accompany a geological map and section of the Lowa Ghur or Sheen Ghur Range in the District Bunnoo, Punjab; with analysis of the lignites. Asiatic Society of Bengal Journal, 34(2), 42-47.

This is a list of plate description accompanying the geological map of the area. It also has description of the samples collected during field visits.
Key words: Geological map, Sheen Ghar, lignite, Bannu, Punjab, India.

V/11. Verchere, A.M., 1867. Geology of Kashmir, the Western Himalaya, and the Afghan Mountains, with a note on the fossil by M.E. Verneuil. Journal of the Asiatic Society Bengal 35, part 1: 89-133, 159-203; part 2: 9-50, 83-115, 201-229.

Shows that the so-called nummulites obtained in the Kashmir valley by Messrs. Vigne and Flemming were crinoid stems. The author considers that the tertiary 'Murree beds' are crushed against the older rocks of the Kajnag range and that the peaks of the latter are composed of porphyry (granite), probably of igneous origin. The lower part of the Kashmir limestone series is classed as of Carboniferous age, and is shown to rest on amygdaloidal and slaty rocks, some of which are considered to be lavas, other trap-ashes more or less altered, and other again unaltered detrital sedimentaries. The higher beds of the limestone series, for which the name Kothair is proposed, are considered to be possibly of Triassic age. The trap is considered to have altered the limestones of part o0f the Kashmir valley, and is accordingly regarded as intrusive and of post-Carboniferous age.

Key words: Geology, palaeontology, Kashmir, Himalaya, Afghanistan.

V/12. Verma, R.K., 1992. Seismicity, focal mechanism and plate movement along the western margin of the Indian plate. Abstracts, First South Asia Geological Congress, Islamabad, p.44.

Seismically the western margin of the Indian plate extends from the Makran cost in the south (nearly 25^0 N) to Hindukush (35^0 N). However the effect of plate collision extends upto north Pamir, S. Tien shan region. Seismically the area which are particularly active are the Kirthar-Sulaiman region, Quetta transverse ranges, Hazara Thrust region, Kohistan region and the North Pamir region. Most of the territory of Pakistan is characterized by strike-slip as well as thrust faulting. This is true to a large extent of the Hindukush and the North Pamir region alos. Over the Hindukush region the seismic zone extends to a depth of nearly 240 km. here a complex system of faulting is also taking place. At a depth of 80-240 the principal stress axis are oriented N to NW as well as S to SE.
Seismically the Hindukush region cannot be explained in term so of a simple plate subduction model. It appears that the lithospheres corresponding to the Indian and the Eurasian plate are moving relative to each other upto a considerable depth.
Key words: Seismicity, plate movement, Indian plate.

V/13. Verma, R.K., 1992. Gravity field in NW Himalaya, Kohistan region and the nature of continental-continental plate collision. Abstracts, First South Asia Geological Congress, Islamabad, p.44.

A Bouguer anomaly map of NW Himalaya, N. Pakistan and parts of Kohistan-Hindukush region has been prepared using all available gravity data. The map shows a pronounce gravity high over the Kohistan region. The gravity field has been interpreted along two profiles. The first extending from Gujranwala to Haramosh massif in NNE-SSW direction and the other from Gujranwala to Ghizar through Kohistan region.
Along the first profile the Moho depth is found to increase from nearly 30 km near the edge of the Indian shield to 77 km underneath the Haramosh massif. Along the second profile a high density intrusive in the upper part of the crust and located close to the Main Mantle Thrust is invoked in order to explain the observed gravity field. The intrusive extends to a depth of nearly 20 km and must have come from the upper mantle.
The nature of isostatic compensation prevailing in the Himalaya will be discussed. The results do not support a simple model of plate subduction along the NW Himalayan front. The role of vertical tectonics in the formation of Himalaya is emphasised.
Key words: Gravity, plate collision, Kohistan, Himalaya.

V/14. Verma, R.K., 1994. Gravity field in NW Himalaya, Kohistan region and the nature of continental-continental plate collision. In: Ahmed, R. & Sheikh, A.M. (Eds.), Geology in South Asia--I. Proceedings of the First South Asia Geological Congress, Islamabad, 1992. Hydrocarbon Development Institute of Pakistan, Islamabad, 147-152.

Consult the preceding account for further information.
Key words: Gravity, plate collision, Kohistan, Himalaya.

V/15. Verma, R.K. & Gosh, S., 1994. Seismotectonics and nature of plate movement in Hindukush Region. In: Ahmed, R. & Sheikh, A.M. (Eds.), Geology in South Asia--I. Proceedings of the First South Asia Geological Congress, Islamabad, 1992. Hydrocarbon Development Institute of Pakistan, Islamabad, 141-146.

For details consult the following account.
Key words: Seismotectonics, plate movement, Hindukush.

V/16. Verma, R.K., Mukhopadhyay, M. & Bhanja, A.K., 1980. Seismotectonics of the Hindukush and Baluchistan Arc. Tectonophysics 66, 301-322.

A seismicity map of that part of the Pakistan-Afghanistan region lying between the latitudes 28° to 38°N and longitudes 66° to 75°E is given using all available data for the period 1890–1970. The earthquakes of magnitude 4.5 and above were considered in the preparation of this map. On the basis of this map, it is observed that the seismicity pattern over the well-known Hindukush region is quite complex. Two prominent, mutually orthogonal, seismicity lineaments, namely the northwestern and the north-eastern trends, characterize the Hindukush area. The northwestern trend appears to extend from the Main Boundary Fault of the Kashmir Himalaya on the southeast to the plains of the Amu Darya in Uzbekistan on the northwest beyond the Hindukush. The Sulaiman and Kirthar ranges of Pakistan are well-defined zones of intermontane seismicity exhibiting north-south alignment.

Thirty-two new focal-mechanism solutions for the above-mentioned region have been determined. These, together with the results obtained by earlier workers, suggest the pre-dominance of strike-slip faulting in the area. The Hazara Mountains, the Sulaiman wrench zone and the Kirthar wrench zone, as well as the supposed extension of the Murray ridge up to the Karachi coast, appear to be mostly undergoing strike-slip movements.

In the Hindukush region, thrust and strike-slip faulting are found to be equally prevalent. Almost all the thrust-type mechanisms belonging to the Hindukush area have both the nodal planes in the NW-SE direction for shallow as well as intermediate depth earthquakes. The dip of P-axes for the events indicating thrust type mechanisms rarely exceeds 35°. The direction of the seismic slip vector obtained through thrust type solutions is always directed towards the northeast. The epicentral pattern together with these results suggest a deep-seated fault zone paralleling the northwesterly seismic zone underneath the Hindukush. This NW-lineament has a preference for thrust faulting, and it appears to extend from the vicinity of the Main Boundary Fault of the Kashmir Himalaya on the southeast of Uzbekistan on the northwest through Hindukush. Almost orthogonal to this NW-seismic zone, there is a NE-seismic lineament in which there is a preference for strike-slip faulting.

The above results are discussed from the point of view of convergence of the Indian and Eurasian plates in the light of plate tectonics theory.

Key words: Seismotectonics, plate movement, Hindukush.

V/17. Verma, R.K., Mukhopadhyay, M. & Roy, B.M., 1977. Seismotectonics of the Himalaya and the continental plate convergence. Tectonophysics 42, 319-335.

The relationship between seismicity and tectonics of the northwestern, central and part of the eastern Himalaya lying between longitudes 74–88°E and latitudes 26–35°N has been studied. A seismicity map of the area for the period 1890–1970 is presented. A strain-energy release map of the Himalaya was prepared following the method discussed by Allen et al. (1965). On the basis of this map it is suggested that the Himalaya does not behave as a single unit so far as the seismic activity is concerned. It could be divided appropriately into three different units;

(1) the Panjab Himalaya;

(2) the Kumaon Himalaya; and

(3) the Nepal Himalaya.

It is suggested that the extension of Aravalli structures into the Himalayan regions has played a role in the tectonics of the Kumaon Himalaya, and probably is the cause of the complex nature of seismicity of the region.

In the Kumaon Himalaya the maximum strain-energy release is related to the Main Central Thrust (MCT), whereas in the Panjab as well as in Nepal Himalaya it is related to the activity of the Main Boundary Fault (MBF). The strain-energy release characteristics of the two thrusts show that their mechanisms of storage and release of energy are different. Strain-energy release through the MCT seems to be more uniform as compared to the MBF along which the release of energy has been mostly abrupt, through large magnitude earthquakes.

Focal-mechanism solutions of Himalayan earthquakes located north as well as south of the Indus Suture Zone indicate that the Indian plate is underthrusting the Tibetan plate towards the north, wehereas the latter is underthrusting the Indian plate towards the south. P-axes lying to the north as well as south of the Indus Suture Line are shallow dipping. This confirms the view that the present-day seismicity of the area is a result of continental-continental collision and not of lithospheric subduction.

Key words: Seismotectonics, plate movement, plate convergence, Himalaya.

V/18. Verma, R.K., & Sekhar, C.C., 1983. Seismicity of Pakistan and its relationship to faults and lineaments. Geophysics Research Bulletin, 21(3), 209-223, Hyderabad.

Key words: Seismicity, faults.

V/19. Verma, R.K. & Sekhar, C.C., 1986. Focal mechanism solutions and nature of plate movements in Pakistan. Journal of Geodynamics, 5 (3–4), 331–351.

From the seismic point of view, the territory of Pakistan which lies between latitude 23°–37° N and longitude 61°–75° E is one of the most active zones in the world. The importance of this area lies in terms of movements of the Indian plate with respect to Eurasia on the west. Seismicity, as well as focal mechanism- solutions, throws a considerable light on the nature of forces acting in the area. All the available solutions, along with 12 new ones, have been considered for the present study. Their relationship to major faults in the area is discussed. The majority of the solutions in the central and northern parts show strike-slip faulting with a left-lateral sense of motion, followed by thrust faulting; few show normal faulting. This suggests that the Indian plate is moving with respect to the Eurasian plate along the Chaman fault, Quetta transverse zone, Sulaiman Ranges and the Hazara thrusts region joining the Hazara/Kashmir syntaxis. The orientations of P and T axes have been studied. It is seen that in a large number of cases compressive stress is acting nearly in NNW-SSE to N-S directions. The Hazara thrust region appears to be the most complex. Here, the influence of the Himalayan thrust front is evident to a large extent.
The nature of faulting along the Chaman fault and Quetta transverse zone is to some extent similar to that of the San Andreas fault system of California. So far as the energy release is concerned, the maximum energy is being released in the form of strike-slip movements close to the Chaman fault and Quetta transverse ranges.
Key words: Plate movement, tectonics, Hazara.

V/20. Verplanck, P.L., 1986. A field and geochemical study of the boundary between the Nanga Parbat-Haramosh Massif and the Ladakh arc terrane, northern Pakistan. M.Sc. thesis, Oregon State University, 138p.

Key words: Geochemistry, plate boundary, NPHM, Ladakh arc.

V/21. Verplanck, P.L., Snee, L.W. & Lund, K., 1985. The boundary between the Nanga Parbat massif and the Ladakh island arc terrain, north Pakistan: A cross fault on the Main Mantle Thrust. American Geophysics Union 66, 1074; Washington.

Key words: Plate boundary, structure, NPHM, Ladakh arc.

V/22. Vicary, M., 1851. On the geology of the upper Punjab and Peshawar. Geological Society of London, Quaternary Journal 7, 38-46.

Introductory Remarks by Sir R. I. Murchison. In communicating the enclosed letter from Major Vicary to myself, I beg to observe that he obtained his knowledge in an arduous campaign, which led the British forces into regions ordinarily inaccessible to geologists. Independently of the description of an extensive range of those younger tertiary deposits in the Sewalik hills, Avith the contents of which we have been made acquainted through the letters of our associates Falconer and Cautley, Major Vicary now calls our attention to Palaeozoic fossils derived from the mountains which separate British India from Cabul. It appears that Dr. Falconer had previously obtained possession of fossils establishing this point, and I would now state that when I last visited Edinburgh, the Rev. Dr. Fleming showed me Producti and Sjnriferi collected by his son Dr. A. Fleming, of the Company's Service, in the vicinity of the salt range at Musakhail on the east bank of the Indus, which seemed to be identical with carboniferous forms well known in the British Isles. Being unaware at that time of any similar discovery, I urged my friend, the Rev, Dr. Fleming, to make his son's researches known to the scientific world, and to compare exactly the species collected in Western India with those of Scotland, with which he is so conversant. Having since shown these fossils to M. de Verneuil, he has identified five out of eight or nine species with forms well known in rocks of this age in other parts

of the world, viz. Productus Cora, D Orb. Orthis crenistria, Phill. costatus, Sow. Terebratula Royssii, L'Eveille, and seve- Flemingii, Sow. = P. lobatus, Sow. ral other species of this genus.
Now these fossils have already been known to have an enormous geographical range; the Productus Cora occurring in Peru, Spitzbergen. Northern Europe, and the Sierra Morena of Spain; whilst two or three of the other species have an almost equally extensive distribution. The observations of Major Vicary are thus augmented in value by the discoveries of Dr. A. Fleming; for they prove that the palaeozoic rocks have a considerable range in the region of the Indus, a fact hitherto unknown to European geologists.
Key words: Geology, Paleozoic, Siwaliks, Punjab, Peshawar, India.

V/23. Victoria, J.J., 1998. Hydropower - An energy source for the Northern Areas of Pakistan. In: Stellrecht, I. (ed.), Karakorum-Hindukush-Himalaya: Dynamics of Change. Culture Area Karakorum, Scientific Studies, 4. Rudiger Koppe, Koln.

Key words: Hydropower, energy resources, Gilgit-Baltistan.

V/24. Vigne, G.T., 1842. Travelers in Kashmir, Ladakh, Iskardo, etc. 2nd edition. Colburn.

This is a 500+ pages book about the area. The first few paragraphs from the first chapter are reproduced here.
“At the village of Suru, not far from Bowun, is a well-sculptured figure of Sri, the Indian Ceres, or Lucksmi, as the goddess of plenty, in black marble, and about two feet in length, being the best specimen of the kind that I know of in Kashmir.
Proceeding along the northern side of the Karywah of Islamabad, we arrive at the place where the higher ranges begin to descend upon it; and at this spot alone, near the highest end of the valley, the most ungeological would be convinced of its having once contained a lake, as the remains of beaches formed of shingly conglomerate, are to be seen there deposited in horizontal layers, and resting upon distorted limestone strata. But I have before noticed this place, in my general remarks made upon entering the valley. Close at hand are some small ancient excavations in the limestone-rock, even with the ground, but not displaying any ornamental sculpture: They appear to be made for shelter rather than for any other purpose; at least I was not able to discover one.
Above them is a porch, elevated to the perpendicular face of the rock in which it is cut. The old pathway has been much injured, and I clambered up with some difficulty. Within is a small antechamber, from which a few steps lead into another excavation behind it; but I was deterred from going beyond the entrance, by the stench arising from the innumerable bats that I disturbed, which was rendered absolutely insupportable by the great heat of the weather. The Musalman, I may here remark, says that the bat was originally formed from a piece of clay, which Jesus Christ was accidentally moulding with his fingers, and that God gave it life afterwards, for the sake of its divine maker.
The excavation, is a dark and dismal-looking place, well suited to the purposes and trickery of priestcraft, which I have little doubt from its appearance were in full play within and near it. Perhaps this is the unfathomable cave which Abu Fuzl says is on one side of the springs of Bawun. On the ground, are the ruins of two Hindu temples, of the same shape as the interior building of Martund. The fine strath which I was ascending was the Pergunah of Kahawa, or Kaurah Parah. Kahawa signifies the left, and Parah is a corruption of Pergullah.
Duchin signifies the right, and Duchin Parah, is on the right side of the river Lidur, which flows downwards through the 8trath, to bear to ajunctioll with the Jylum, about three miles above Bij Beara. It is a very large river, inferior only to the Veshau, and when swollen with rain or melted snows its flood rushes down towards the plain with great impetuosity.
Harput Nag, or the Bears Spring, may be visited either from or on the way to Eysh Makam. It lies at the extremity of a strath that well deserves its name, being covered with the wildest jungul. I saw a wild cat, and my dogs unharboured a young bear, at which I got a snap shot; but he escaped to the mountains, by shuffling away at a pace I could not have given him credit for. The place is remarkable for its copper-mine, which formerly gave employment to numbers of workmen; but such is the arbitrary and oppressive nature of the Sikh rule that it is not now worked at all. Sher Singh, when governor of the valley, tried all he could to induce the people to resume their labours, but without effect. When compelled to work they will bring the demanded quantity of ore, but take particular care that it could produce little or no metal, and their masters know nothing about the matter. It is useless to attempt.to punish them: the unfortunate Kashmirian is quite aware that his wages would probably not be paid, that the produce of his labour will nevertheless be taken, and that the display of a little will be the sure incentive to a demand for more; and these are reasons far more cogent than those that cause a strike amongst European operatives. I entered what I was informed was the principal mine. It extended into the quartzose rock, in a slanting direction, for not more than

twenty-five yards. The interior was much coloured by a nitrate of copper. I procured what purported to be specimens of the ore, but suspect that they were not of the best."
Key words: Tourism, Kashmir, Ladakh, Skardu, Baltistan.

V/25. Villa, I.M., 1997. High-grade amphibolites in Baltistan: t, T, p, Z, aH_2O, $^{\tau}xx$, N_{φ}. Abstract volume, 12th Himalaya-Karakorum-Tibet International Workshop, Rome, Italy, 95.

Amphibolites from NW Ladakh Terrain and the Karakorum Metamorphic Complex in N Pakistan record $p \leq 1$ Gpa and $T \leq 700$°C. In metabasites of the Ladakh-Kohistan island arc (Askore amphibolites, Shyok Suture Zone) and in gneisses of the adjoining Karakorum metamorphic complex (Chogo Lugma area, Remendok pluton) and High Himalayan Naga Parbat-Haramosh Massif, amphiboles and micas give Late Miocene-Pliocene ages {Villa et al., Tectonophysics 260 (1996) 201; Villa et al., Schw. Min. Pet. Mit. 76 (1996) 245}. What is really controlling ages in this high-grade terrain? Temperature? Plotted in a conventional t-T diagram, samples do not define a meaningful family of "cooling paths". Pressure? No. These amphibolites contain none of the excess Ar typical of eclogites {Tonarini et al., Terra Nova (1993) 13}. Only one gneiss of NPHM contains excess Ar (Ar/Ar biotite plateau=15 Ma, muscovite plateau=9.8 Ma, biotite Rb/Sr=5.7Ma).
Porosity? Dahl {GCA 60(1996) 3687} establishes crystal fields as controlling diffusion in crystals (surprise to so many!). The amphiboles in the metabasites have quite similar composition but ages scatter between 10 and 70 Ma. Resetting of Albian arc volcanics mainly depends on something faster than diffusion. Water? Of course it is known to enhance diffusivity by orders of magnitude. This is why virtually immobile elements such as Pb in zircon can be used as geohygrometers. Regional fluid movement is the only way to homogenize Sr over the tens of km diffusion length scale implicitly required if WR Rb/Sr measurements are seen as metamorphic ages. The Rb/Sr data indicate open-system exchange with a fluid. Strain? if looked for, differences between deformed and undeformed muscovites a few meters apart are quite obvious, and correlate with ages. Phase mixtures? from Ar correlation diagrams, multiple generations of phases in the handpicked mineral separates can be diagnosed. Electron microprobe confirms $N(\varphi) \geq 2$ where predicted by Ar. The key point is, where a texturally older amphibole or muscovite is still preserved, it also preserves an old age, reinforcing the notion that temperature alone won't reset all minerals. In summary, an age determination by no mean obviously translates into "Tt point". For this to happen, one must look at dry static rocks such as the Proterozoic Limpopo belt which exceeded the temperature necessary to erase any inheritance {Kamber et al., J Geol 103 (1995) 493}. In wet, hectic young orogens faster processes, such as recrystallization induced by deformation and fluids, overrun the very sluggish thermal diffusion in resetting mineral ages.
Key words: Amphibolites, Ladakh, Karakorum metamorphic complex, Baltistan.

V/26. Villa, I.M., Lemennicier, Y. & Le Fort, P., 1996. Late Miocene to early Pliocene tectonometamorphism and cooling in south central Karakoram and Indus-Tsangpo Suture, Chomo Lungma areag(NE Pakistan). Tectonophysics 260, 201-214.

The Chogo Lungma glacier is located at the northeastern edge of the Nanga Parbat-Haramosh spur where the Ladakh-Kohistan arc formations are laminated between the Karakorum and High Himalaya units. In the Karakorum metamorphic complex, metamorphism of a pelitic and granitic protolith took place in two tectonometamorphic phases. Isoclinal folds (□700°C, 1 GPa) were followed by doming (□630–700°C, 400–750 MPa) in a compressional climax (Lemennicier et al., 1996). One hornblende and two biotites associated to syntectonic magmatism with mantle affinities, contemporaneous of doming, give cooling ages between 3.0 and 7.7 Ma. A muscovite from an orthogneiss in the Karakorum gives an age of 5 Ma. Fast cooling (70–110 K/Ma) has prevailed ever since. Two muscovites from a foliated intrusion emplaced on the thrust of the Ladakh-Kohistan arc over the High Himalaya Crystallines have ages of 8.2 and >9 Ma (despite being collected in the same locality), dating the thrust at just before 9 Ma. All this points to a coeval tectonometamorphism and thrusting in that area during the Tortonian.
Key words: Miocene, Pliocene, metamorphism, tectonics, Karakoram, Indus-Tsangpo suture.

V/27. Villa, I.M., Ruffini, R., Rolfo, F. & Lombardo, B., 1996. Diachronous metamorphism of the Ladakh terrain at the Karakorum-Nanga Parbat-Haramosh junction (NW Baltistan, Pakistan). Schwitz. Mineral. Petrogrog. Mitt. 76, 245-264.

Metamorphic minerals from gneisses, amphibolites and schists of the Himalaya-Ladakh/Kohistan syntaxis in NW Baltistan were dated by $^{39}Ar/^{40}Ar$ stepwise heating.
The amphiboles from the Askore Amphibolite unit sampled in the Indus valley give discordant age spectra with step ages ranging from 35 to 70 Ma; we interpret the older step ages ns mixtures between relict amphibole cores and new overgrowths. At least in the case of an amphibolite from the NW basal part of the Askore Amphibolite located just above the Main Mantle Thrust, a discordant age spectrum can be quantitatively interpreted using isotope correlations supplemented by petrographic observations and microprobe analyses. The cores retained their Ar during a 600-650^{0}C amphibolite facies overprint. In the Shyok Suture Zone, amphibole ages are much younger, between 9 and 14 Ma. The young radiometric ages are thought to be associated with new amphibole formation along the foot- wall of the Main Karakorum Thrust.
Three biotite ages from the Shyok Suture Zone range between 6 and 8 Ma, similar to that from the NW part of the Askore Amphibolite, while two biotites from the Askore Amphibolite further SE give ages around 35 Ma, very close to the coexisting hornblendes. Biotites from the "Layered Sequence" of the Nanga Parbat-Haramosh Massif contain excess Ar, as shown by comparing 3yAr/4"Ar biotite ages (15 and 27 Ma) with muscovite 3"ArI4lAr ages (10-12 Ma) and a two-point biotite-plagioclase RbSr age of 5.6 Ma.The RbISr age may point to open-system fluid circulation and/or to Sr inheritance in plagioclase. The muscovites probably date the initial stages of the still-continu- ing formation ol the Nanga Parbat-Haramosh Massif antiform.
The Askore Amphibolite underwent amphibolite metamorphism before 35-40 Ma, followed by rapid exhumation.The Karakorum Metamorphic Complex was thrust over the Shyok Suture Zone between 10-15 Ma, thermally overprinting it. One Askore Amphibolite sample from the basal part of the LadakhTerrain records a Late Miocene thermal overprint related to the young high-grade metamorphism and penetrative deformation affecting the "Layered Unit" of the Nanga Parbat-Haramosh Massif.
Key words: Metamorphism, tectonic evolution, Ladakh, Himalaya.

V/28. Villa, I.M., Tonarini, S., Oberli, F., Meier, M., Spencer, D.A., Pognante, U. & Ramsay, J.G., 1992. Eocene age of eclogite metamorphism in Pakistan Himalaya. Abstract Volume, 7th Himalaya-Karakoram Workshop, Department of Earth Sciences, Oxford University, England, 94.

High-pressure rocks with an eclogitic assemblage (omphacite-garnet-quartz-rutile) from the Himalaya were first described by Spencer et al. and Pognante & Spencer. A geochronological Investigation on two eclogites using the Sm/Nd, Rb/Sr. U/Pb and Ar/Ar methods is presented here. We obtained ages of 49±6 (Sm/Nd on garnet-clinopyroxene pair). 43±1 (Rb/Sr on phengite-clinopyroxene pair). 40±1 (U/Pb on rutile), 91±5 and 82±1 Ma (Ar/Ar isochron on hornblende and plateau on phengite, respectively). The Sm/Nd isotopic system was fully equilibrated during eclogitization and not disturbed since; its mineral ages may date the peak metamorphic conditions (650±50C at 13-18 kbar . The Ar/Ar ages indicate that high-pressure minerals may give statistically acceptable but geologically meaningless numerical results. The other three mineral chronometres agree with the post-Cretaceous age proposed on paleomagnetlc grounds by Klootwijk et al, for the collision between the Indian and Asian plates. The collision, subduction and the eclogitlc metamorphic peak was already completed in the NW Himalaya by 50 Ma, although not in the Central and Eastern Himalaya before this time.
Key words: Eclogites, High-P metamorphism, Eocene, Kaghan, Himalaya.

V/29. Villa, I.M., Zanchi, A. & Gaetani, M., 2001. Rb-Sr dating of the Tirich Mir pluton, NW Pakistan: pre-140 Ma accretion of the Karakoram terrane to the Asian margin. Journal of Asian Earth Sciences 19, p.72.

Key words: Rb-Sr dating, plate collision, Tirich Mir pluton.

V/30. Vinassa De Regny, P., 1932. Hydrozoen und korallen aus der ob. Trias des Karakorum. Wissenschaftliche Ergebnisse der Dr. Trinkler schen Zentralasien-Expedition, 2, 192-196. Reimer, Berlin.

Key words: Hydroids, corals, Triassic, Karakoram.

V/31. Vince, K.J. & Treloar, P.J., 1993. Late-stage extension along the Main Mantle Thrust (Pakistan, Himalaya): New field and microstructural evidence. Abstract, Volume, 8th Himalaya-Karakoram-Tibet Workshop, Vienna, p.81.

Recent geochronological work on metamorphic rocks from the Besham area of North Pakistan has yielded evidence of re-activation of the Main Mantle Thrust as a zone of late-stage crustal extension. This has been accommodated in the footwall and hangingwall by displacement along a set of E-W striking normal faults. This trend is roughly parallel to that of the Main Mantle Thrust. Local variations in strike occur as a result of folding of the Main Mantle Thrust into a minor syntaxis around the Besham region. The E-W trending normal faults cut across all the earlier ductile and brittle structures produced by south-verging deformation and are therefore late-stage.

E-W trending south-dipping normal faults in the Indian Plate rocks of the Main Mantle Thrust footwall exhibit topside to the south movement. Extensional fabrics displace the northerly dipping ductile shear fabric of the footwall rocks that were formed as a result of the collision between the Indian plate and Kohistan Island arc although, on a smaller scale, some extension was accommodated by brittle re-activation along fabric surfaces. These can be interpreted either as Riedel shears associated with the earlier south-verging thrusts or, surfaces along which extensional collapse of the entire metamorphic pile occurred. Riedel shears are also associated with a few of the E-W trending faults.

The Kohistan Island arc forms the hangingwall of the Main Mantle Thrust. E-W trending normal faults occurring in the ultramafic rocks can be divided into two groups according to their movement: topside to the south, similar to the footwall and topside to the north. The latter are developed parallel or sub-parallel to the shear fabric of the hangingwall rocks. This is not as well developed as the fabric of the footwall sequence but implies clear north-verging extension. Many minor extensional faults are associated with the larger scale faults in the Kohistan ultramafics.

A second set of normal faults, striking N-S, are associated with the late deformation which folded the Main Mantle Thrust into a minor syntaxis producing an antiform in the Besham region. This east-west directed extension was more pronounced in the hangingwall of the Main Mantle Thrust than in the footwall and is attributed to outer-arc extension of the developing fold.

Key words: Geochronology, microstructure, extension, MMT, Besham.

V/32. Vince, K.J. & Treloar, P.J., 1995. Early-Miocene-aged northward extension along The Main Mantle Thrust, Northwest Himalaya, Pakistan. Abstract Volume, 10th Himalaya-Karakoram-Tibet Workshop, (ETH Zurich) Switzerland.

During the early stages of the Himalayan orogeny rocks of the Kohistan Island Arc were thrust southwards onto the Indian Plate along the Main Mantle Thrust (MMT), a northerly-dipping south-vergent crustal-scale fault zone. As a result, the cover sediments of the Indian Plate were decoupled from the lower-to middle-crustal basement and imbricated along large-scale thrusts. Crustal thickening of the decoupled Indian basement occurred beneath Kohistan by means of internal imbrication, ductile shearing and recumbent folding producing considerable thicknesses of blastomylonites (Treloar et al., 1989). Later thrusts re-imbricated cover and basement rocks and led to further thickening of the Indian Plate as the south-vergent thrusting of Kohistan over the Indian Plate continued. During the phase of thrusting the basement gneisses and granitic lithologies of the Indian Plate developed a strong south-vergent S-C fabric, and were mylonitised in zones of very high shear strains.

However, the presence of high-grade metamorphic rocks on the footwall and low-grade rocks on the hangingwall of the MMT suggests that the crustal-scale fault was later reactivated as a zone of extension. For instance, to the west of the Indus River kyanite-bearing rocks of the Swat Nappe in the footwall of the MMT are in structural contact with blueschist and greenschist facies rocks of the melange sequence (Treloar et al., 1991). To the east of the Indus chlorite-rich metasediments of the Banna Nappe structurally overlie sillimanite grade gneiss at the top of the Hazara Nappe.

Field investigations have illustrated that the mylonitic gneisses and granitic rocks of the Indian Plate immediately below the MMT contain abundant northerly-dipping C' shear surfaces (Platt & Vissers, 1980; Cobbold et al,. 1971; Cosgrove, 1976). These ductile shear structures extensionally displace all the earlier south-vergent S-C fabrics in a top-to-the-north sense within the upper 30m of the MMT footwall. However, with increasing depth below the MMT the abundance of the extensional shears decreases rapidly over a relatively narrow zone.

At depths greater than 30m beneath the fault the late-stage deformation is accommodated along brittle transposed mylonitic fabric surfaces which carry N-S trending slicken fibres. Extension fractures and large E-W trending, north-dipping normal faults become progressively more dominant with increasing distance into the footwall of the MMT. However, no evidence for the extensional deformation is observed at depths > 400m beneath the MMT. This indicates either that the late-stage extension was partitioned into a very narrow zone immediately below the fault or, that the zone of ductile shearing was initially much thicker but has since been thinned or cut-out by the later brittle faulting. This is consistent with crustal extension during the transition from ductile to brittle deformation processes, as the ductile extension progressively thinned the crust it allowed cooling to take place which eventually led to brittle extension.

Metamorphic discontinuities also exist within the Indian Plate itself. The north-dipping Banna Shear juxtaposes the low-grade Banna Formation metasediments at the base of the Banna Nappe against the high-grade Mansehra Granite gneiss at the top of the Hazara Nappe. The topside-to-the-north extension has been accommodated along dominantly ductile C' shear surfaces within the gneissic footwall of the fault. As observed within the granitic rocks immediately below the MMT the majority of the northerly-dipping north-vergent ductile extensional shears are concentrated within the top 30-40m of the footwall but are sparse at greater depths.

The north-verging extensional displacements have been accommodated within the low-grade hangingwall of the Banna Shear along north-vergent fold and thrust structures and small-scale conjugate sets of north- and south-dipping normal faults. With increasing distance from the shear zone the extensional structures become progressively more brittle.

Field and laboratory evidence suggests that the Banna Shear either developed contemporaneously with the north-vergent deformation along the MMT or represents the extensional reactivation of a southerly-dipping backthrust which originally thrust low-grade metasediments northwards in association with a phase of brittle imbrication within the Indian Plate. However, there are no late-stage north-vergent structures within the low-grade metasediments which outcrop in the root zone of the proposed backthrust to support the former origin for the Banna Shear.

Microstructural and geochemical investigations have shown that the late-stage ductile C' shears within the footwall rocks of both metamorphic discontinuities developed in association with the retrograde shearing of muscovite and biotite mica during a phase of north-vergent normal displacements. As a result the extensional shears are defined by very fine-grained cataclastic biotites and the growth of new biotite and chlorite. Quartz has undergone dominantly ductile deformation within the granitic and gneissic lithologies. Mica 'fish' show ductile shearing into the C' surfaces at the onset of extension and water brittle fracturing as the deformation continued. Feldspar porphyroclasts underwent dominantly brittle deformation with the formation of sheared and rotated domino fault blocks, which dip to the south. Core and mantle textures around plagioclase porphyroclasts show a lower Anorthite (An) content within the recrystallized mantle, suggesting a retrograde metamorphic event.

On the basis of field criteria, reaction products and microstructural observation, it is likely that late-stage north-vergent extension along the MMT operated under conditions characteristic of greenschist facies metamorphism. Differences in fission track ages exist across the MMT between the footwall and hanging wall rocks. The zircon blocking temperature is recorded as 45Ma in Kohistan and only 20Ma in the Indian Plate. However, the lower temperature apatite ages of 19-l6Ma (Zeitler, 1985) contour at the same structural level across the fault. This suggests that the phase of northward extension along the MMT was early Miocene in age, synchronous with north-vergent extension within the main Himalayan chain, where it is believed to have been driven by uplift along the Main Central Thrust (MCT). There is no obvious MCT analogue within the Pakistan Himalaya, The question thus arises as to whether late orogenic extension is a function solely of relatively shallow level thrusting or a result of isostatic adjustment following over thickening of the deep crust.

Key words: Orogeny, tectonics, Eocene, Kohistan island arc, MMT, Himalaya.

V/33. Vince, K.J. & Treloar, P.J., 1996. Miocene, north-vergent extensional displacements along the Main Mantle Thrust, NW Himalaya, Pakistan. Journal of the Geological Society of London 153, 677-680.

Structural data from N Pakistan show that early Tertiary, S-vergent structures within the upper part of the Indian Plate and the Himalayan suture zone were overprinted by regionally developed N-vergent extensional structures. Such extension has been suggested, but not previously described from the NW Himalaya. Cooling histories suggest extension was Miocene in age. Extension was most likely the result of isostatic rebound resultant from crustal, or lithospheric, thickening and/or delamination.

Key words: Tectonics, MMT, Miocene, Himalaya.

V/34. Virdi, N.S., 1981. Presence of parallel metamorphic belts in northwest Himalaya - Discussion. Tectonophysics 72, 141-146.

Kumar (1978) has recently described two belts of metamorphics from the northwestern Himalaya on the basis of the low pressure-high temperature and high pressure-low to high temperature mineral assemblages. Of the two belts, the southern corresponds to the Central Crystallines while the northern consists of Puga and Sumdo formations. Further it has been suggested (op. cit., p. 126) that the two belts together constitute a pair similar to those observed in California, Japan and Taiwan. Kumar also is not clear in his views on the nature of the Indus Suture Zone. Though firstly (op. cit., p. 122) he regards it as “nothing but a deep mantle-reaching fault” represented by a zone of ophiolites, later, however (p. 130), he describes it as marking the trench at the continental margin along which ocean bed was dragged down, in other words a subduction zone. This “suture” or “deep seated fault” is supposed to separate the Himalaya proper from Tibeto-Karakorum Range of “altogether different geological province”. It may be pointed out here that Crawford (1974) was the first to have suggested the Indus Suture to be a deep mantle-reaching fault and not a subduction zone; Kumar, however, has not referred to this work. Geological investigations by the author and others both in Ladakh, Karakorum and the Central Crystallines have shown that the ideas presented in the paper are highly inconsistent with th e actual geological set up in the region and the various models proposed to account for the geo-tectonic evolution of the Himalaya (Shankar et al., 1976; Gansser, 1977; Virdi et al., 1977; Virdi, 1980; and Frank et al., 1977). Also the Indus Suture does not separate the Karakorum from the Himalaya but, as will be discussed, it forms an important link between the two.
Key words: Metamorphic belts, Himalaya.

V/35. Virdi, N.S., 1979. On the geodynamic significance of mega lineaments in outer and lesser regions of western Himalaya. Himalayan Geology 9, 79-99.

Two types of mega-lineaments one trending NW-SE and conforming to the Himalayan strike and the other transverse to it are observed on the Landsat imagery of the Outer and Lesser regions of the western Himalaya. A majority of these lineaments coincide with known thrusts and faults while the others have exercised a profound control on the topographic features in the area through which they traverse. The NW-SE trending linear have also controlled the limits of sedimentary basins and exercised influence on intensity of deformation during and after the sedimentation. The transverse linears have rotated or dislocated the longitudinal linears and they can be traced southwards through the piedomont zone and probably coincide with deep-seated faults in the basement under the alluvial cover.
Key words: Geodynamics, lineaments, Himalaya.

V/36. Virdi, N.S., 1987. Metamorphic belts in the Indus-Kohistan suture zone and its surroundings: Evolution in space and time. In: Sychanthavong, S.P.H. (ed.), Crustal Evolution and Orogeny, 221-248.

The western segment of the Indus-Tsangpo suture zone in Kohistan and Ladakh and the southern margin of the Karakorum exhibits three important metamorphic belts which are more or less continuously traceable from west to east. The northernmost belt, the Pongong-Baltit metamorphic belt forms the basement of the Karakorum and contains older rocks metamorphosed and intruded by granitic batholiths. The regional metamorphism (M,),, probably Late Jurassic to Early Cretaceous, was superimposed by contact metamorphism (M,) during the Late Cretaceous. Younger events related to the collision of the Indian and the Tibetan plate during the Eocene also affected these rocks, resulting in widespread thrusting and retrogression. The Gilgit-Shyok belt lying farther south consists of metamorphosed sediments, volcanics and tuffs formed in a magmatic arc and the back-arc basin north of the Kohistan-Ladakh magmatic arc. The metamorphism is of the low to medium pressure-medium to high temperature type and varies in intensity from greenschist to amphibolite in Ladakh and from greenschist through amphibolite to pyroxene granulite facies in Kohistan. The prevailing geothermal gradients are high, varying from 30" to 37"C/km and the grade increases due south towards the magmatic arc. South of the magmatic arc in Ladakh, a belt of fore- arc flysch occurs between the Gilgit-Shyok and the Indus-Kohistan belts. However, northwest of Dras in the Deosai and Nanga Parbat regions, the two belts occur in close juxtaposition. The high pressure belt consists of blueschists in Ladakh and blueschists and garnet-granulites in Kohistan. These have been derived from the ophiolitic

melange and the ultrabasic-rocks under high pressure-low temperature to high pressure-high temperature conditions with low geothermal gradients (15^0-18^0C/km). The high-pressure and low-pressure belts constitute paired metamorphic belts that developed in a Pacific type subduction zone at the southern margin of Tibet during the Cretaceous. A two- stage model for the evolution of these metamorphic belts is proposed.
Key words: Metamorphic belts, Indus-Kohistan Suture zone, Karakoram.

V/37. Virdi, N.S., 1981. Geotectonic evolution of the Indus Suture zone. In: Sinha, A.K. (ed), Contemporary Geoscientific Researchs in Himalayas I, Tectonics, Regional Geology and Biostratigraphy, 131-136.

Key words: Geotectonics, Indus Suture Zone, Himalaya.

V/38. Virdi, N.S., 1992. Cretaceous marginal basins of the Indus-Kohistan collision zone, development and evolution, 157-168. In: A.K. Sinha (ed.), Himalayan orogen and global tectonics. Oxford and IBH, New Delhi.

Key words: Collision, Cretaceous, Indus-Kohistan, Himalaya.

V/39. Visser-Hooft, J., 1926. Among the Karakoram glaciers in 1925. Edward Arnold: London.

Key words: Glaciers, Karakoram.

V/40. Visser, C.F. & Johnson, G.D., 1978. Tectonic control of late Pliocene molasse sedimentation in a portion of the Jhelum Re-entrant, Pakistan. Geol. Rundschau, 67, 15-67.

Several studies have related the cyclic aspect of the sandstone-mudstone repetition in the Siwaliks to complex stream systems. A genetic relationship has been demonstrated between these fluvial cycles and aggrading stream systems of varying sinuosity. The paper covers the flood plain stratigraphy in the Upper Siwaliks of the Potwar. The Markov chain analysis is applied to a portion of the stratigraphy at the Gauss/Maruyama polarity transition in a number of places in the area. From this they derived the principal deposition facies in a region of contemporaneous gluvial deposition. The rocks may have formed in a frequently flooded, sedimentation-dominant flood plain environment. Deep pedogenic overprinting may have occurred much later than the active migration of the stream course.
Key words: Tectonics, sedimentology, Pliocene, Siwaliks molasse, Jhelum.

V/41. Visser, P.C., 1928. Von den Gletschern am Obersten Indus. Zeitschrift fur Gletscharkunde, 16, 169–229.

Key words: Glaciers, Indus.

V/42. Visser, P.C., 1932. Gletcheruberschiebungen im Nubra und Shyok– Gebeit des Karakorums. Zeitschrift fur Gletscharkunde, 20, 29–44.

Key words: Glaciers, Shyok, Karakoram.

V/43. Visser, P.C., 1934. The Karakoram and Turkestan Expeditions of 1929-30. Geographical Journal 84, p821.

Difficult though it may be to give in a limited space an account of an expedition which took more than one and a half year and which not only had a geographical aim, but at the same time had in view the investigation of geological, glaciological, zoological, botanical, and meteorological problems, I will nevertheless try to give in a

narrow compass a synopsis of our third expedition to the mountains of central Asia. This time our object was first of all to explore the as yet unknown regions of the Karakoram and Saltoro-Karakoram (formerly known as Kailas-Karakoram) lying in the upper course of the Shyok and Nubra rivers. In this part of the Karakoram, which differs entirely from that which we visited in 1925 in Hunza, it looks as if Nature had tried not to compress the greatest possible number of mountain ranges into the smallest possible space, as is the case in Hunza, but just to model them on a wider base, thereby leaving space between the mountains and ranges, as if to show them better. Whoever has admired a Jungfrau or Bernina, a Mont Blanc or Breithom, will be able to understand that Matterhorns are not always required to make a landscape charming and impressive. In the Saltoro-Karakoram we found however almost perpendicular granite walls among the highest in the world, and we found mountains which need yield to none as regards beauty and majesty.
Our programme further included the exploration of the tableland, at that time still unmapped, which is situated to the east of the Karakoram Pass and the regions of the Kunlun, which confine it on the north; also observations on the borderlands of the Taklamakan desert. Not only did we intend to map out as carefully as possible the mountains which we had chosen for exploration, but also to *try* to find out something more about the connection of the Karakoram and Aghil mountain ranges and their continuation eastwards.
Key words: Geology, geography, glaciology, zoology, Karakoram, Turkestan.

V/44. Visser, P.C., 1935. Glet cheruberbeobachtun gen im Karakorums. Zeitschrift fur Gletscharkunde, 22, 22–45.

Key words: Glaciers, Karakoram.

V/45. Visser, P.C. & Visser-Hooft, J. (Eds.), 1935-1940. Karakorum Wissenschaftliche Ergebnisse der Niederlandischen Expedition in den Karakoram und die Angrezenden Gebiete in den Jahren 1922, 1925, 1929-1939, und 1935. E.J. Brill: Leiden. 1938, Volume 2, Glaziologie; 1940, Volume 3, Geologie, Palaontologie und Petrograhie.

Key words: Geology, glaciology, palaeontology, petrography, Netherlands Expedition, Karakoram.

V/46. Viterbo, C. & Zanettin, B., 1959a. Caratteri petrografici e chimismo della massa gnessica granitoide affiorante fra Skyo e valle dell Tormik (Karakorum occidentale). Rendiconti della Societa Mineralogica Italiana 15, 283-309.

Describes the petrographic characteristics and geochemistry of granitic gneisses of the Skyo and Nubra area.
Key words: Petrography, geochemistry, granitoid, Karakoram.

V/47. Viterbo, C. & Zanettin, B., 1959b. I filioni lamprofirici dell'alto Baltoro (Caracorum). Memorie dell, Accademia Patavina dei Scienze, Lettere ed Arti 71, 1958-1959, 3-39. Padova.

The Baltoro area is essentially occupied by granitic rocks. This paper describes lamprophyric dykes within the area.
Key words: Lamprophyre, Baltoro, Karakoram

V/48. Vogeltanz, R., 1968. Ein seltenes Fossil aus dem Hindukusch. Der Deutscher Alpenverein, Bd. 93, 159–160.

This account gives details about a rare fossil in Hindukush area.
Key words: Palaeontology, fossils, Hindukush.

V/49. Vogeltanz, R., 1970. Receptaculites neptuni (Defrance) from Devonina of Owir An, Chitral, West Pakistan. Record of Geological Survey of Pakistan, Quetta, 19, 4p.

Key words: Palaeontology, Devonian, Chitral, Hindukush.

V/50. Vogeltanz, R., & Diemberger–Sironi, M.A., 1969. Receptaculites Neptuni Defrance aus dem Devon des Hindukusch. Osterreichische Akademie der Wissenschaften, mathematisch–naturwissenschaftliche Klasse, Anzeiger, Bd. 105, 100–101.

Key words: Palaeontology, Devonian, Chitral, Hindukush.

V/51. Vokes, H.E., 1935. Unionidae of the Siwalik Series. Connecticut Academy of Arts and Sciences, Memoirs, 9, 37-48.

Key words: Unionidae, Siwaliks.

V/52. Vokes, H.E., 1936. Siwalik Unionidae from the collection of the Second Yale North-Indian Expedition. Geological, Mining and metallurgical Society of India, Quarterly Journals, 8, 133-141.

Key words: Unionidae, Siwaliks.

V/53. Voillot, P., 1994. Der wilde weg zu den aquamarinen. Lapis 19(11), 38-45.

Key words: Gems, aquamarine.

V/54. Völk, H., 1999. Deep-seated mass rock creep along the Karakoram Highway in the middle Indus valley near Chilas, Northern Pakistan, with special focus on the interaction between erosion, valley fill and mass movements. Terra Nostra 99 (Abstract Volume, 14th Himalaya-Karakoram-Tibet Workshop, Kloster Ettal, Germany), 164-165.

Unexpected sudden landslides along the Karakoram Highway (KKH) are a common and feared phenomenon, but the causes have scarcely been related to processes of persistent rock creep, which are to be presented here. Mass rock creep in motion cannot be experienced by direct observation because of being an extremely slow type of mass movement; the rate of velocity measures only app. < 1-10 mm/a. However the results of these extremely slow rock movements morphologically conspicuous and important from the point of view of engineering geology, especially along glacially eroded valley flanks. It is the change in geotechnical properties, which is linked with rock creep and impairs the stability of valley slopes (Selby 1985; Chigira, 1992; Cruden & Varnes, 1996). Geologically speaking the mountainous region of Chilas is made up of mafic-ultramafic plutonites of a former oceanic island arc, which have entered the geological literature as Chilas Complex of the Sub-Kohistan Arc in the Karakoram (Kazmi & Jan, 1997; Searle & Asif Khan, 1998). Although the Indus valley bottom at Chilas (Middle lndus) only lies at 1030 in asl this trunk valley course of the lndus was glaciated, too, as well as filled up by sediments and deeply eroded several times (Shroder et al., 1993).

Through the enormous incision of both glacier and river processes, which have to compensate for the amazing uplift of the high mountain chains of the Karakoram and the adjacent Nanga Parbat Massive, a deep trough valley with high and steep valley flanks came into being. Mass rock creep in the sense of deep-seated gravitational slope movement (down to 300 m) accompanied by opening of joints, fracturing and dilation, can be observed especially on those places where the lndus river has exposed or undercut the rock flank by recent or subrecent entrenchment. The fluvial disposal of Quaternary valley fill, such as till, gravel, lake deposits etc., deprives the valley slopes on the stoss sides of the river from their support at the footwall. As a consequence the rock walls are progressively failing and exhibiting various phenomena of collapse structures sometimes even reaching the mountain tops and ridges, adjacent to the valley. In the course of our-study on mass rock creep in the region of Chilas, app. 8 km up- and downstream of this village, we can distinguish mainly two modes of slope failure:

Plane failures, consisting of several massive rock sheets (slabs) sliding into each other, indicating listric bending of shear planes in thc distal part near the slope foot, representing a primary system, resulting in concave slopes.
Toppling failures, consisting of numerous plate-like rocks segments near the distal margin of plane rock sheets, representing a secondary system superimposed on the plane failure system (1), resulting in convex slopes. Most geotechnically active joints along which plane failures occur, correspond in position with the regional “layering” of the meta-gabbros dipping towards NE, whereas joints of toppling type steeply dip in the opposite direction (SW) since they are frequently symmetric to the first ones and therefore show the same strike direction. Depending on the respective shear stress in the valley flanks other potentially active joints might also appear enabling the slope to attain general mobility.
Results
The geomorphological result of deep-seated rock creep is a prograding slope foot, thus a narrowing of the valley bottom. Conspicuous fracturing of rocks and opening of joints in outcrops along the KKH must be ascribed to mass rock creep rather than to tectonics. The conclusion must be that probably all events of rockfall are caused and controlled by mass rock creep on the valley flanks. This is particularly important for engineering work along the KKH.
Key words: Deep-seated rocks, geomorphology, Indus valley, KKH.

V/55. Volk, H.R., 2000. Deep-seated mass rock creep along the Karakoram Highway and its geomorphological consequences in the middle Indus valley near Chilas, Northern Pakistan. Geological Bulletin, University of Peshawar 33, 11-27.

Unexpected sudden landslides along the Karakoram Highway (KKH) are a common and feared phenomenon, but the causes have scarcely been related to processes of persistent rock creep, which are to be presented here. Mass rock creep in motion cannot be experienced by direct observation because of being **an** extremely slow type of mass movement; the rate of velocity measures only - 1-10 mm/a. However the results of these extremely slow rock movements are morphologically conspicuous and important from the point of view of engineering geology, especially along glacially eroded valley flanks as in the case of the Indus valley course in question. Mass rock creep in the sense of deep-seated gravitational slope movement produces irregular slope profiles with trenches accompanied by opening of joints, fracturing and dilation. As a consequence the rock walls are progressively failing and exhibiting various phenomena of collapse structures sometimes even reaching the mountain tops and ridges, adjacent to the valley. In the course of our study on mass rock creep in the region of Chilas, - 8 km up- **and** downstream of this village, we can distinguish mainly two modes of slope deformation.
1. Toppling movements, consisting of numerous book-like rock segments on the upper slope, rotating out of the slope, representing a primary system, resulting in convex slopes, sections through bulging.
2. Sliding movements, consisting of several massive rock (slabs) slowly gliding downwards upon each other, showing secondary listric bending of shear planes in the distal part near the slope foot, representing a secondary system, resulting in concave slopes. Geologically speaking the mountainous region of Chilas is made up of mafic ultramafic plutonites of a former oceanic island arc, which have entered the geological literature as Chilas Complex of the Kohistan Arc in the Karakoram.
Key words: Deep-seated rocks, geomorphology, Indus valley, KKH.

V/56. Voskresenskiy, I.A., Kravchenko, K.N., Movshovich, E.B. & Sokolov, B.A., 1971. An outline of the geology of Pakistan (in Russian). Nedra, Moscow, 168p. 6 tabs., 61 figs.

Key words: Geology.

V/57. Voskresenskiy, I.A., Kravchenko, K.N. & Sokolov, B.A., 1965. Tectonic subdivision of West Pakistan. 17th All Pakistan Science Conference, Karachi.

This is a brief of the tectonic subdivisions of Pakistan describing the major faults and plates of the country.
Key words: Tectonics.

V/58. Voskresenskiy, I.A., Kravchenko, K.N. & Sokolov, B.A., 1968. The tectonics of West Pakistan. Geotectonics 2(2), 93-99.

Key words: MCT, structure, Miocene, Himalaya.

V/59. Vredenburg, E.W., 1907. Note on the distribution of genera Orthophraqmina and Lepidocyclina in the Nummulitic series of Indian Empire. Geological Survey of India, Records 35(1), 62-67.

Key words: Palaeontology, India.

V/60. Vredenburg, E.W., 1908. The Cretaceous Orbitoides of India. Geological Survey of India, Records 36, 171-213.

Key words: Palaeontology, orbitoids, Cretaceous, India.

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Key words: Palaeontology, Eocene, Tertiary formations, India.

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Key words: Palaeontology, Eocene, Tertiary formations, India.

V/64. Vyvyan, M., 1939. A Journey in the Western Karakorum. Alpine Journal, 51, 231-242.

The author has passed through the Himalaya and Karakorum. This is his findings during the journey. As this is a travelogue with no abstract. Thus the first few pages from the article are presented here.
The present conventions of Himalayan travel, which is now perhaps in its classic period, somewhat resemble those of Alpine travel in its corresponding stage nearly a century ago. In each case it is usual to explain, if not to justify, being among high mountains by some accomplishment in the way either of practical mountaineering or geographical or scientific investigation, but the subsequent development of Alpine mountaineering inclines one to the belief that these purposes and accomplishments are rather the mould or pattern of mountain experience than the essence of it. This belief is, at any rate, the excuse for the present paper describing a short journey in the western Karakoram last year which has no accomplishments to its credit. Indeed, to return to my comparison, this account will probably read to students of serious Himalayan undertakings much as some ' Narrative of an Excursion to the Aar Glacier ' did three quarters of a century ago to those following in contemporary Alpine literature the progress of attempts on the Matterhorn and the triangulations of Adams Reilly.
The plan with which Campbell Secord and I started from England for Gilgit in the first days of June 1938 was to explore the upper basin of the Kunyang Glacier, the first large northern tributary met in ascending the Hispar, and

from it to make, if possible, a pass across the western end of the main Karakoram as the range at this point is sometimes regarded. The outskirts of the western Karakoram are perhaps more familiar to travelers than any other part of the Himalaya, for here roads and settled valleys probably reach nearer than elsewhere in the world to very great mountains. The main range is cut by the Hunza valley and the famous Gilgit road between Kashmir and Sinkiang which follows the river, while its southern fork terminates in the knot of Rakaposhi where the Hunza bends to the S. But although the approaches to these mountains have been frequently visited since Conway's great traverse of the Hispar and Baltoro in 1892, not only his work but that of later high-level explorers such as the W orkmans and the Vissers seems to have been continually hampered by bad weather. - For this reason, mainly, the Kunyang Glacier, dominated by Disteghil Sar (25,868 ft.) and Pumarikish (or Kunjut No. 2, 24,580 ft.) had not been penetrated far enough for the latter mountain to be· seen, and the attraction of these recesses led Campbell Secord and myself to follow Colonel Mason's recommendation to visit it. If in exploring the upper basin we could find a col leading to the Malangutti or Yazghil Glaciers, this might be the route between the Hispar and Shimshal valleys which has been reputed to exist among local inhabitants on each side of the range. As it turned out, the party which did reach the northern end of the glacier was not adequate for summit ridge climbing nor equipped for proper surveying. This was the more unfortunate in that the weather was more continually flawless during my brief journeys than I have ever heard of it being among such great mountains ; the benevolence of the skies seemed to be a contemptuous gift considering their treatment of our more competent predecessors.

Secord and I came up from Abbottabad in the N.W. Frontier Province via Chilas, a route which is more rapid but gives a longer stretch of the desert Indus valley than the more alpine Kashmir road. Neither of us had been to the Himalaya before and our first sight of great mountains was therefore one of our summer's more important happenings. It fell to us on entering the Indus valley; they were far away to the W. in unadministered tribal territory and looked like broken blue stones. Not till a few days later did 've see high mountains in full white panoply and then there was suddenly the stupendous mass of Nanga Parbat, complicated and alone to the S., and Haramosh and a slice of Rakaposhi (25,550 ft.) to the N. It was this very first revelation of Himalayan decolletes that distracted us from our serious purposes. Looking at them as we lay among long grass in one of the little carpet-like oases that are spread at intervals on the desert shelf above the Indus and its tributaries, we reflected that Kunyang was at least a week of sandy marches further away than the foot of Rakaposhi, and that our feet longed for the more familiar accidents of rock and snow, so 've resolved on a temporary defection. Shortly after we reached Gilgit, therefore, we left on a flying visit to the base of Rakaposhi in order to prospect its N.W. ridge which no one seemed to have approached before, but which looked promising from some R.A.F. photographs in our possession. Crossing the browri surf of the Hunza in a native ferry of inflated skins, whose rowers showed great skill and power, was the only sensational part of this preliminary journey, and then we had one of the most unusual pleasures of mountain travel that of gaining height unexpectedly at the end of the same day. After we had marched through sand which scorches even local porters' feet in the heat of the day, our path wound .some 6oo ft. up a precipitous gully in what we thought was merely a detour to avoid a cliff jutting out into the river, but reaching the top we found there was no descent. We were in a luscious green alp in the Jaglot valley which we had been making for, and whose main exit seems to be a fairly sheer drop over a cliff which only the Jaglot stream passes on its way to join the Hunza. We camped above Jaglot and the next day we reached the base of our ridge at some 12,500 ft.; we found it at least worth trying and were well on our way down the Hunza valley by nightfall. In fact we were back in Gilgit in 2-1/2 days after leaving it, having covered about So miles and, up and down, some 16,000 ft. in that time, travelling alone with packs and two walking ponies for some of the way.

Key words: Karakoram.