ENGINEERING NEWS

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ENGINEERING NEWS

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Contents

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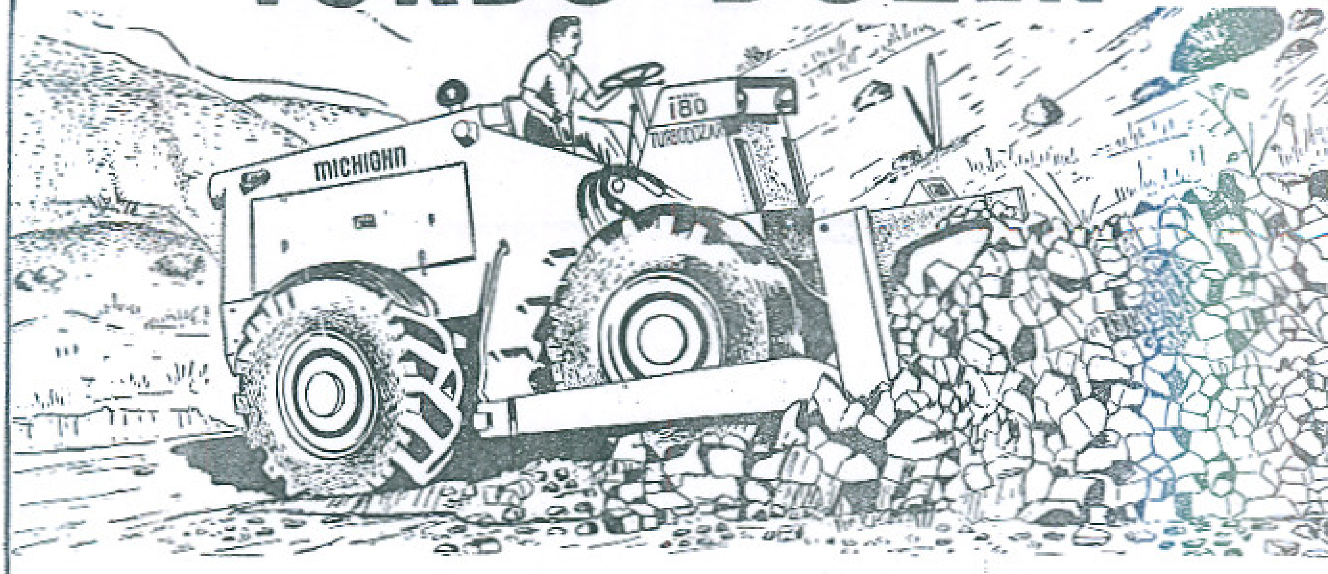

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ASSOCIATED COMPANIES BRANCHES WORKS AND AGENCIES THROUGHOUT THE WORLD.

Editorial

The publication of the Five-Year Plan has raised the question as to what should be the role and contribution of the engineer in planning the development of the country and in the work of framing the connected policy. This is not only a pertinent question, for on its answer depends the ability of the engineer to play his proper part in national reconstruction and development, but also a very timely one, as it focuses attention on the recent administrative re-shuffling in West Pakistan whereby the engineer has been rendered inoperative so far as devising the higher policy in regard to his own sphere of work is concerned.

We have no desire either to start a controversy or to indulge in one, but we consider it our duty to remind members of the engineering profession as well as the authorities concerned of the vital role which the engineer is playing today in bringing Pakistan to the line of advanced and developed nations. More than anyone else it is the engineer who is helping to harness the natural resources of the country to productive and materially beneficial purpose; it is the engineer who is labouring day and night to broaden the field of industry; and it is again the engineer on whose capacity to "deliver the goods" depends the success of such schemes, plans and projects which are aimed at raising the general standard of life in the country. It is incomprehensible, therefore, that in view of the achievements expected from him the engineer should not only be restrained from acquiring his proper position in the scheme of things but also be deprived of the authority and privilege which were his for so many decades.

Many of our readers who have had the opportunity of studying the development and building programmes of advanced nations in Europe and America will testify to the fact that there the engineer is supreme not only at the executing stage but also at the planning stage, and above that even at the stage of policy-making. This is as it should be. For who but an engineer can fully and properly appreciate the various ramifications, technical and other, of an engineering project? It is not for the uninitiated administrator, a non-specialist, to understand the importance, the advantages and the drawbacks (let alone the subtle implications) of a scheme which has to be drawn up and implemented by engineers. It is no wonder, therefore, that in progressing countries the worth and utility of the engineer is duly recognised and acknowledged and he is allowed the widest possible latitude in the exercise of his intelligence and ability in nation-building works. Some of the countries make it a point to see that the highest public representative responsible for engineering development works is an engineer. The example of Soviet Russia should convince the Doubting Thomases; there the Minister of Power Stations,* a former Prime Minister, is himself an electrical engineer by training. One can only say after this that the current arrangement in West Pakistan which has deprived the engineer of his due share in the policies of the province is a retrogressive step, the baneful effects of which will soon be realised by the authorities.

We have reproduced in this issue a lecture by Qazi-Zahur Husain, in which he has thrown some light on the circumstances which led to the dissociation of the engineer from the governmental stage of administration and its likely results on development schemes. If some of our detractors should hesitate to give value to his observations, since he is an engineer himself, we would invite their attention to a speech of no less a personality than the Chairman of the Planning Board, which is also reproduced. Mr. Zahid Husain is no engineer and he has no cause to be partial to engineers. We shall conclude by quoting him and leave the judgement to our readers:

> "A complete divorce of execution from policy does not contribute to speed in execution and seriously restricts the ability of the technicians to make their full contribution..... The status and remuneration of scientists and technicians should be brought on a level with those of general administrative services in recognition of their importance and utility in this industrial age."

**M. Georgi Malenkov.*

ONE-UNIT HOUSING PROJECT

*by Muhammad Akram**

As soon as the Administrative Council was charged with the integration of West Pakistan, one of the most immediate questions it faced was to find residential accommodation for officers and staff of the new Government.

After an appraisal of the available accommodation in the city it was found that although immediate needs of office accommodation could be met by adjustment and squeezing of various offices, it was not possible to find residential accommodation at reasonable cost to the Government employees.

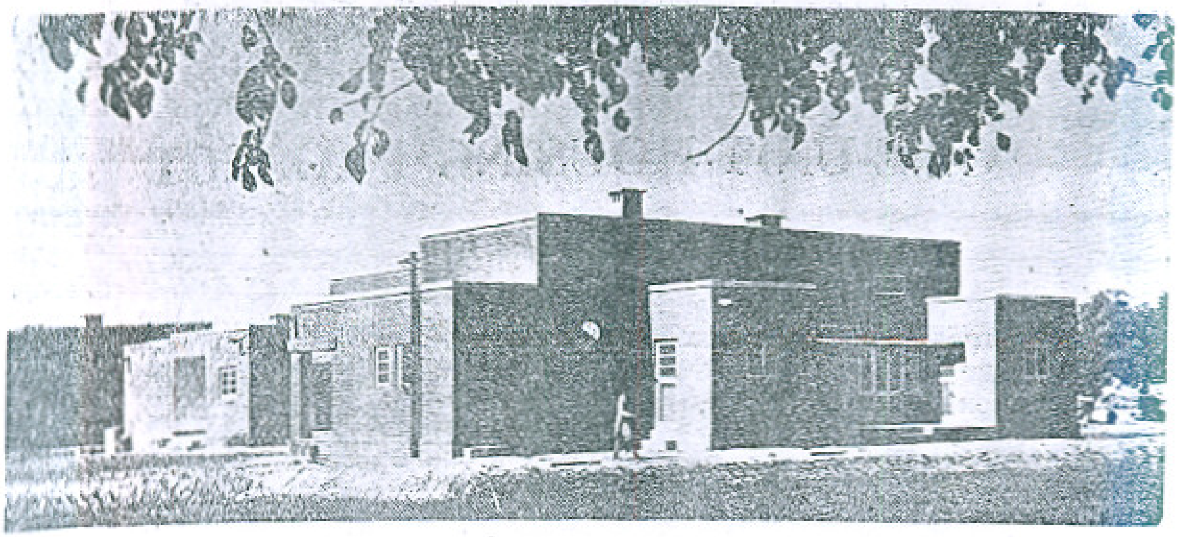
It was decided, therefore, to undertake a huge programme of construction of permanent residential quarters for Government servants especially the low paid ones. It was decided to construct 1,234 staff quarters, 12 junior and 17 senior officers' residences in the first phase and 71 junior, 23 senior and 9 Ministers' residences with high school, hospital, etc., in the second phase. With this programme in view, the Construction Circle of the Buildings and Roads Department, was opened in June, 1955, and charged with the duties to complete as soon as possible 1,000 staff quarters on Katcha Multan Road, now known as Wahdat Colony, at an estimated cost of Rs. 86,00,000, 234 staff quarters at Poonch House costing Rs. 23,58,600, seventeen senior officers' residences on Danepur Lane and Bahawalpur House at a cost of Rs. 14,69,500 and 12 junior officers' residences in Bahawalpur House at Rs. 5,11,394.

This project of Rs. 1.3 crore was to be completed within a year. The immensity of the job can be gauged by comparison with the residential construction during 100 years of British rule which amounted to 52 senior officers' and 34 junior officers' residences and 374 clerks' quarters.

During this short period sites were to be selected and acquired, Improve-

A general view of the Wahdat Colony, housing 1,000 families.

**Superintending Engineer, Build ings & Roads Department.*



One of the numerous new bunga lows built for One-Unit officers.

ment Trust formalities settled and an immense quantity of materials arranged.

To crown all these difficulties, the floods of October 1955, the worst in living memory, upset all the plans. The biggest headache for the speedy construction was the manufacture and procurement of bricks, the burning of which was hampered by rain and other difficulties.

It was estimated that about 6.63 crore of bricks alone would be needed. It was, therefore, decided to manufacture bricks after putting up P.W.D. kilns all over Lahore, as the private kiln owners, having realized the enormous demand and the priority attached to it, raised the rates of the bricks. The rates quoted were from Rs. 29 to Rs. 35 per thousand at kiln site against the P.W.D. rates of Rs 23|12|- per thousand provided in the estimates. The procurement of 20,000 tons of coal required for burning these bricks, was another problem and for this purpose a special sub-division was formed at Quetta to arrange for purchase, payment and quick transport of coal. It was indeed a wonder that despite all these handicaps the bricks were produced in time to meet the schedule. These details of each project are given in the following paragraphs:

POONCH HOUSE

This scheme provided for the construction of 234 double storeyed, two and three-roomed quarters for Unit Secretariat Staff in an area of 139 kanals Designed artistically the colony which has been completed and occupied has its own tube-well, modern sanitation, roads, foot-paths and open spaces. Being near the Secretariat this colony is very popular.

WAHDAT COLONY

This is the largest Government residential scheme ever undertaken before or after partition anywhere in Pakistan. The scheme envisaged construction of three-roomed quarters for 200 senior clerks and superintendents, 500 two-roomed quarters for senior clerks and 300 two-roomed quarters for junior clerks and peons at an administratively approved cost of Rs. 84,09,000|-|-. The scheme is to cover an area of 250 acres which needed a lot of levelling.

When completed the Wahdat Colony will be self-contained in every respect and will have community facilities for a population of 8,000 to 10,000. It will have four primary schools, two each for boys and girls, and a high school each for boys and girls, a dispensary with maternity-cum-child welfare centre, a police station, a post office, a market, residential quarters for the doctor, a club, play-grounds and, in fact, every modern facility needed for a self-contained unit. The colony has its own tube-well, flush fittings, properly lighted metalled roads etc., and is already bustling with life.

BAHAWALPUR HOUSE

This scheme is on an area of 556 kanals, and comprises 12 junior officers' and 4 senior officers' residences. It is proposed to construct another 28 junior officers and 23 senior officers' residences.

DANEPUR ROAD SCHEME

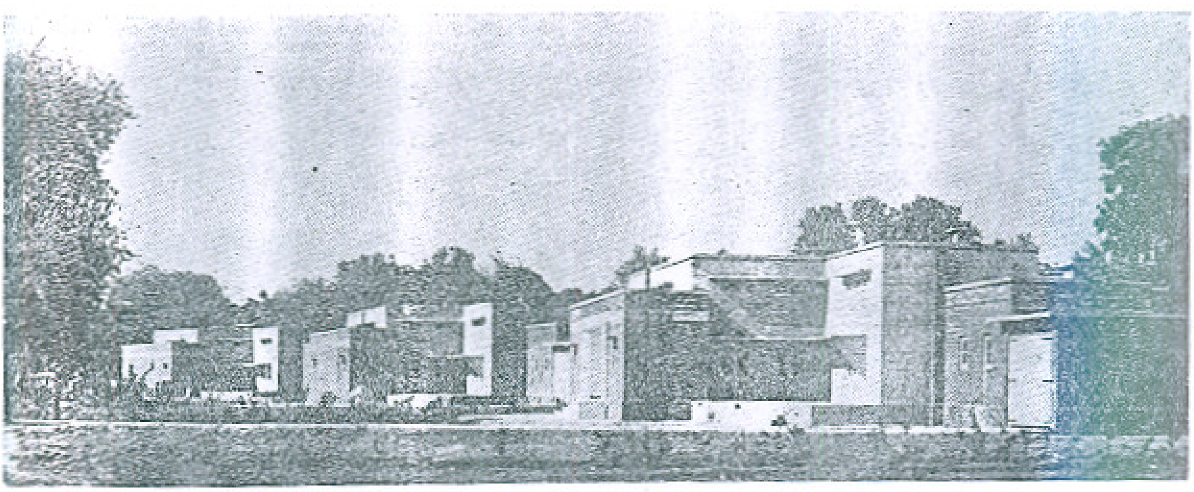
This scheme is planned in an area of 135 kanals. Only 13 senior officers' residences, have been constructed, leaving two sites for Ministers' residences, facing the canal. Considering the high cost of maintenance of gardens and the high cost of land in this locality the area and plots adjoining each house have been slightly reduced.

PLINTH AREA RATES

The statement of cost and plinth area for each type of residence is given in table I, which shows the distribution of cost between the building and the development. In table II, the cost actually incurred on buildings including electricity and sanitary fittings inside the building is given. It may be seen that the over-all cost works out to be Rs. 7|9|- per sq. ft. for staff quarters, which is a low figure when compared with the present day prices of materials and labour.

The cost of junior officers' residences and servant quarters works out to be Rs. 11|12|- and Rs. 7|6|- per sq. ft. respectively, which is again fairly low for the type of finishing of floors, gallery and verandahs used and for sanitary equipment and excellent finish of bathroom floors. The cost per sq. ft. of building portion of senior officers' residences is only Rs. 10|12|-, and that of the total building equal to Rs. 12|12|- per sq. ft. The cost of out-houses attached with the senior officers' residences in terms of plinth area rate comes to Rs. 6|12|- per sq. ft.

This project, which was in fact started in November 1955, has been completed within the short time of about 12 months.



New bungalows in Danepur Lane.

STATEMENT No. I OF PLINTH AREA AND COST
ONE UNIT HOUSING PROJECT AT LAHORE

Serial No.	Name of colony.	Plinth area sqft	Cost of Each Building in Rupees: Building	Electric installation	Water supply & Sanitary installation	Tota
1.	1000 STAFF QUARTERS WAHDAT COLONY					
	(a) 3-Roomed quarters 200 Nos.	1523	9782	504	631	10917
	(b) 2-roomed Senior quarters 500 Nos.	795	5338	451	495	6284
	(c) 2-Roomed-Junior quarters 300 Nos.	732	3665	387	250	4302
2.	POONCH HOUSE SCHEME 234 QUARTERS.					
	(a) 2 Roomed quarters (double storeyed) 156 Nos.	870	5828	349	495	6672
	(b) 3-Roomed quarters (double storeyed) 78 Nos.	1380	9642	400	560	10602
3.	BAHAWALPUR HOUSE SCHEME 12-JUNIOR OFFICERS' RESIDENCES					
	(a) Type 3-A 3 Nos.	2248	27392	1632	3561	32685
	(b) Type 3-c 3 Nos.	2478	26783	1632	3561	31976
	(c) Type 2-A 6 Nos.	2500	24931	1632	3561	30124
	(d) Out Houses 12 sets of 2 Nos. each 500	500	3688	—	—	3688
4.	DANEPUR ROAD SCHEME 17-SENIOR OFFICER'S RESIDENCES.					
	(a) Type 'B' 9 Nos.	3422	36247	2636	4124	43007
	(b) Type 'A' 8 Nos.	3546	38236	2636	5361	46233
	(c) Out Houses 17 sets of Nos, each	1477	9800	—	117	9917

STATEMENT OF PLINTH AREA AND COST ONE UNIT HOUSING PROJECTS AT LAHORE

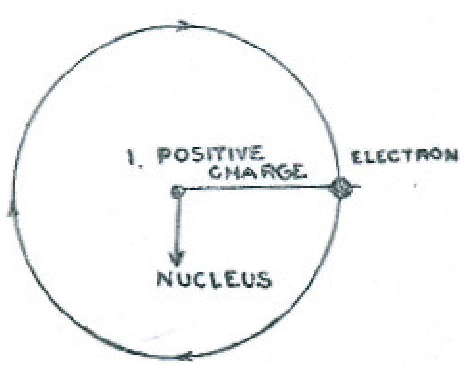
Serial No.	Name of Colony	Plinth Area in 100 S ft.	Cost of Building in Lakh Rupees: Building	Electric installation	Water and sanitary installation	Total	Development cost	Grand Total
1.	1000 Staff Quarters WAHDAT COLONY :-							
	(a) 3-Roomed quarters 200 Nos.	304.6	20.0	1.0	1.3	22.3	Rs. 37.5	Rs. 104.6
	(b) 2-Roomed Senior quarters. 500 Nos.	397.5	27.0	2.3	2.5	31.8		
	(c) 2-Roomed Junior quarters 300 Nos.	189.6	11.0	1.2	0.75	13.0		
2.	POONCH HOUSE SCHEME 234 QUARTERS.							
	(a) 2-Roomed quarters (double (storeyed) 156 Nos.	137.2	9.1	0.54	0.77	10.4	Ks. 3.3	Rs. 22.0
	(b) 3-Roomed quarters (double storeyed) 78 Nos.	107.6	7.5	0.31	0.44	8.3		
	BAHAWALPUR HOUSE SCHEME 12-JUNIOR OFFICER RESIDENCE :-							
	(a) Type 3-A 3 Nos.	6.74	0.82	0.05	0.11	0.98	Rs. 0.89	Rs. 5.08
	(b) Type 3-C 3 Nos.	7.4	.8	0.05	0.11	0.96		
	(c) Type 2-A 6 Nos.	15	1.5	0.1	0.21	1.81		
	(d) Out Houses 12 sets of 2 Nos. each.	6	0.44	—	—	0.44		
	DANEPUR ROAD SCHEME 17-SENIOR OFFICERS' RESIDENCES.							
	(a) Type 'A' 8 Nos.	27.4	2.9	2.21	0.33	3.44	Rs. 6.84	Rs. 14,63
	(b) Type 'B' 9 Nos.	31.9	3.44	0.24	0.48	4.2		
	(c) Out Houses 17 sets of 4 Nos. each.	25.1	0.17	—	0.02	0.19		

Elementary Conception of an Atom

*by Q. Abdur Rashid**

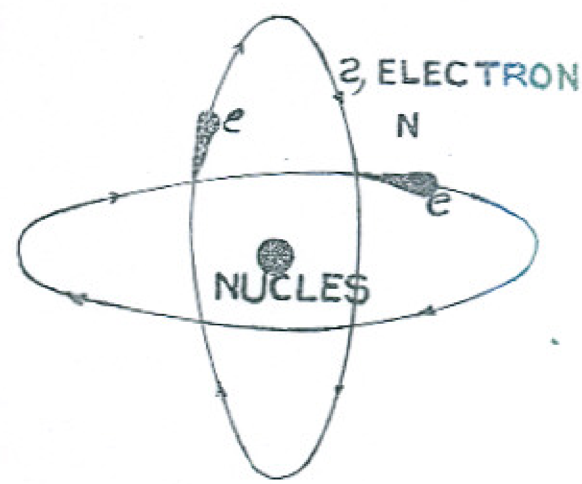
SHAPE OF THE ATOM

Matter is composed of elements of which 96 are known so far. Of these 96 known elements, 88 are foud in nature, the other 8 (technetium, promethium, astatine, fancium, and four identified transuranic elements neptunium, plutonium, americium and curium) have been synthethized in the laboratory. Of the 96 known elements, eleven (argon, chlorine, flourine, helium, hydrogen, krypton, neon, nitrogen, oxygen, radon and Xenon) are gases, two (bromine and mercury) are liquids, and the others are solids, at normal temperature and pressure. The elements consist of atoms (the smallest building blocks of chemical elements, which cannot be divided or broken up by chemical means) which are classified according to the number of electrons present in these. An atom consists of a heavier part called the nucleus around which revolve one or more electrons. The lightest element is Hydrogen which has a single electron revolving round its nucleus (Positively charged) Fig. 1, and its atomic weight is nearly a unit. The second atom is that of helium which has two electrons revolving round it and its atomic weight is four times that of hydrogen. Fig. 2. lithium is the third



HYDROGEN ATOM

FIG: 1



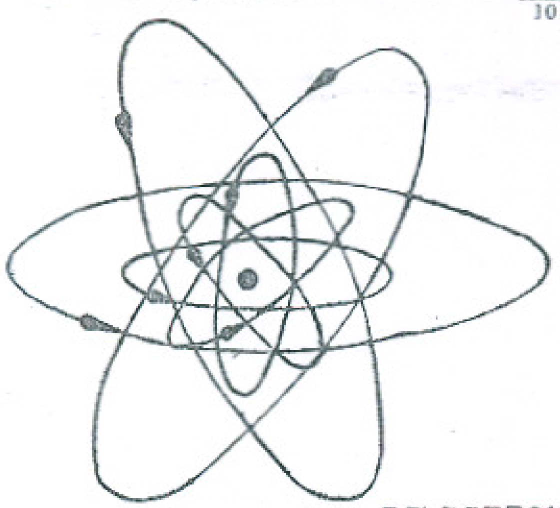
HELIUM ATOM

FIG: 2

element with three electrons revolving round its nucleus and atomic weight 6,940 beryllium is taken as the 4th element with four electrons revolving round its nucleus and atomic weight 10.82. This system goes on till we reach the 92nd element Uranium having 92 electrons and 238 its atomic weight as compared to hydrogen. The last element so far discovered is curium which has 96 electrons revolving round its nucleus and atomic weight 242.

**Principal, Government College, Mianwali.*

The electron is a negatively charged particle and the nucleus has a positive charge and their combination always forms a neutral combination. The electron revolves round the nucleus with a velocity varying between 2.2 to 3.6×10^9 cms|sec, a value which is $\frac{1}{10}$



NITROGEN ATOM, 7 ELECTRONS

FIG.3

of the velocity of light which is equal to 3×10^{10} cms|sec or 186000 miles per second, hence very high. With such velocities electrons can reach the moon in a few seconds.

The charge of the electron is found to be as 4.8036×10^{-10} electrostatic units (e.s.u.) or 1.6012×10^{-20} electromagnetic units (e.m.u.). The atomic weight of hydrogen is 1.008, so one gram of hydrogen atom carries 9573 x 1.008 = 9650 e.m.u. of charge; and the number of atoms in a gram atom of hydrogen (Avogadro's number N) $= \frac{9650}{1.6 \times 10^{-22}} = 6.03 \times 10^{23}$

The mass of an electron (m) is found to be 9.1×10^{-28} gram. The mass of hydrogen atom (M) is 1.67×10^{-24} gram.

Thus $\frac{M}{m} = \frac{1.67 \times 10^{-24}}{9.1 \times 10^{-28}}$ which means that the electron is 1835 times lighter than the lightest hydrogen atom.

The RADIUS of the electron is found to be 1.875×10^{-13} cm, whereas the radius of the nucleus is of the order of 10^{-8} On this conception the picture of the atom of hydrogen or that of helium can be as shown in diagrams 1 and 2. The complexity of the electronic rings can be gauged with increase in the number of electrons. Fig. 3 is that of nitrogen, an atom of which has 7 electrons.

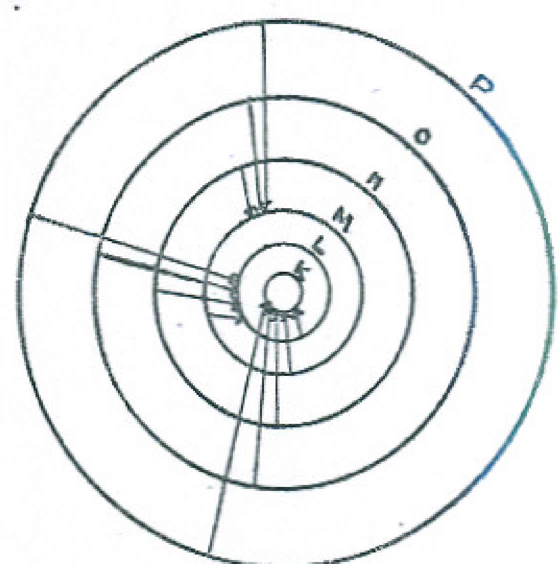


FIG.4 SHELLS AROUND AN ATOM

When an electron is excited by any form of energy, say heat or light or electricity, it jumps from one orbit to another and in so doing certain energy is absorbed. An excited electron while coming back to its normal orbit emits energy and this can be seen as spectral line when viewed through a spectroscope. The various orbits on which hydrogen atom can move about are shown in Fig. 4. If too much energy is given, the electron can be turned away altogether and in this case the nucleus of the atom remains and this is often called an ion.

The chemical and spectroscopic properties of the elements are determined by the number of electrons outside the nucleus. Elements with the same nucleus charge or the same number of electrons outside the nucleus have the same chemical and spectroscopic properties. These properties vary periodically with the atomic number. For example, atoms which have the atomic number 2, 10, 18, 36,........, are inert gases which do not readily combine with other elements. This fact is interpreted to mean that in each of these cases the electrons form stable systems which do not readily combine with the electrons of other atoms.

Atoms such as lithium, sodium, potassium, which have one more electron outside the nucleus than the corresponding inert gas has, have a valency of one and are strongly electropositive. This means that they easily lose one electron and combine readily with elements in which there is a strong attraction for an additional electron. On the other hand, atoms, like fluorine, chlorine and bromine have one electron less than the corresponding inert gas and are strongly electro-negative. They also have a valency of one and strongly attract an additional electron to form a stable group of electrons, such as the groups found in the inert gases.

To explain the periodic variations of the physical and chemical properties of the atoms with an increase in the atomic number it is assumed that only a limited number of electrons can be arranged on a spherical surface with the nucleus as a centre. When the number of electrons exceed the number that can be in stable equilibrium on one spherical shell, they arrange themselves on a series of concentric spherical shells. Thus the distribution of the electrons outside the nucleus is as if they were arranged in a series of spherical shells separated from each other by finite distances. The number of these layers depend on the number of electrons in the atom.

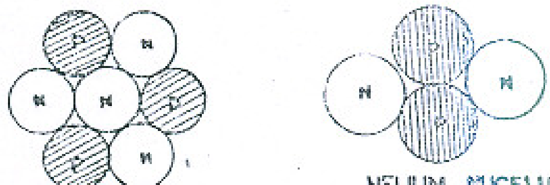
Beginning with the nucleus and moving outward, the first group is known as K-Shell. When it is completed, it contains two electrons. This atom is the atom of helium with an atomic number 2 and an atomic weight of 4. The next group known as the L-Shell, when completed contains 8 electrons. The atom that is formed when shell is completed is neon with an atomic number 10. In building up the L-Shell from the K-Shell, the number of electrons in this shell increases from one to eight and this change corresponds to passing from lithium with an atomic number 3 to neon with an atomic number 10. The formation of the next group, known as the M-Shell, in which there are 18 electrons, corresponds to a transition from sodium with an atomic number 11 to argon with an atomic number 18. A further addition of electrons after the completion of the M-Shell with potassium, whose atomic number is 19. Beyond the next element caecium, there are irregularities in the formation of these shells, but the essential plan of the building remains unchanged.

The electrons in the outside layer are held less firmly by the attractive forces due to the charges on the nucleus than are those on the interior shells. They will therefore be more easily displaced by the action of forces that might be exerted by the neighbouring atoms. It is thus the outer spherical shell of electrons that determines the chemical and spectroscopic behavior of the atom. On the other hand, the electrons near the nucleus are securely held by the electrostatic forces due to the nucleus and can be displaced only with great difficulty. These electrons determine the characteristic X-ray spectra emitted by the elements. These inner electrons are little affected by the presence of neighbouring atoms and change little when atoms enter into chemical combination with other atoms.

THE NUCLEUS: It is the central core of the atom, about which the electrons revolve. It carries a positive charge and it is 2000 times heavier than the electron.

It has been further found that the nucleus is composed of *protons* and *neutrons,* collectively called nucleons. Proton is positively charged particle, the numerical value of the positive charge of the portion is equal to the electronic charge, i.e. 4.8025×10^{-10} e.s.u., or 1.60203×10^{-20} e.m.u. The mass of a proton is about 1847 times the mass of the electron, viz. 1.00758 e.m.u., or $1.6724.8 \times 10^{-24}$ gram, corresponding to an energy of 938 Mev. It is identified as the nucleus of the common hydrogen atom (H). A proton is strongly ionizing, and accelerated to high velocities or energies and is used as sub-atomic projectile to produce nuclear reactions in the target at which it is hurled. On the other hand, a neutron has no charge. Its mass is 1.00893 a.m.u., or 1.6848×10^{-24} gram, i.e. very slightly more than the mass of a proton. Being electrically neutral, it penetrates most solid bodies rather freely, moving through them by diffusion. It produces hardly any ionization at all in air or in other gaseous media. A fast neutron will produce not more than one ion pair per hundreds of centimetres of its path. A neutron is important and very practical agent for the production of nuclear reactions, fission and fission chain reaction; for, being electrically neutral it is not replused by the positively charged protons in the atomic nuclei, and therefore is much better suitable for use as projectile for nuclear bombardment than the positively charged proton. A free neutron may be captured by atomic nucleus and the resulting nuclear reaction usually produces a nucleus of different element.

The number of protons in the nucleus equals the atomic number (Z), the number of neutrons equals the difference between the mass number and the atomic number (A-Z) and the combined total of all the nucleons equals the mass number (A) of the atom. For elements of low atomic weight, Z is approximately half of A, so that such elements contain equal number of neutrons and protons. The example is that of helium and Lithium which have equal number of protons and neutrons Fig. 5. For



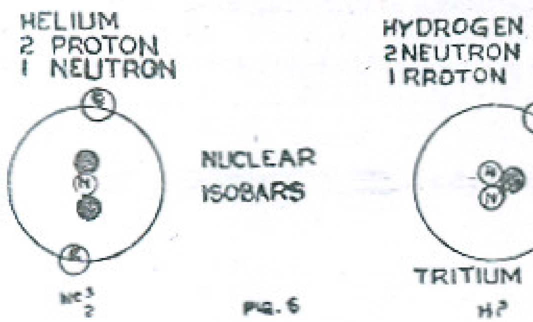
LITHIUM NUCLEUS
3 PROTONS
4 NEUTRONS

FIG.5

HELIUM NUCELUS
2 PROTONS
2 NEUTRONS

elements with higher atomic mass, say, unanium, with atomic number 92 and atomic mass 238, the nucleus consists of 92 protons and 146 neutrons. All atoms of uranium have not the same mass; about 99.3% of it has 238 as atomic mass, 0.7% has 235 and the rest 0.006% has atomic weight equal to 234.

Isotopes and isobars: Nuclei of atoms which belong to different chemical elements (different Z) but have the same mass number (A), are called nuclear isobars; nuclei which belong to atoms of the same element (having same Z) but have different mass numbers (A), are called isotopes. Tritium (the hydrogen isotope-H^3) nucleus contains 1 proton and 2 neutrons, and the (He^3), which has a nucleus composed of 2 protons and 1 neutron, are isobars. Since isobars are isotopes of different chemical elements, their chemical properties are different, and therefore they can be separated chemically (Fig. 6). Isotopes



of the same chemical element have identical extra-nuclear electron structure, and since the chemical properties of all elements are determined by the extra-nuclear electron structure of their atoms, isotopes of the same chemical element have identical chemical properties, and therefore cannot be separated by chemical means. There are many isotopes which for the chemist are varieties of the same element, but can be considered to represent distinct elements for the physicist, due to their different physical properties. Thus ionium is a distnict radioactive element for the physicist, but merely an isotope of thorium for the chemist, since its chemical properties are identical with those of thorium. There occur altogether about 300 different stable isotopes in nature. There are only 23 among the 96 known chemical elements which have no isotopic forms in nature, i.e. which always occur in nature containing atoms of one uniform atomic weight only. All the other elements occur in nature as mixtures of 2 or more isotopes, the proportion of which in any given quantity of the natural element is called natural abundance or relative abundance, or isotopic ratio and is expressed in percentages. It is interesting to note that elements with an even atomic number may have up to 10 isotopes occurring in nature, while those with an odd atomic number have not more than 3 natural isotopes. In addition to the natural stable isotopes, there are more than 500 radioactive isotopes of the 96 elements. All isotopes with an atomic number above 82 are unstable and naturally radioactive, with the sole exception of bismuth isotope ($_{83}Bi^{209}$) As a rule, the atomic weights of different isotopes of the same element differ from each other by about 10%. An important exception is deuterium, the hydrogen isotope, $_1H^2$ the atomic weight of which is the double that of $_1H^1$ The mass numbers of isotopes are always integers or near integers. In writing the name or symbol of an isotope, the rough atomic weight, or mass number, is written as a suffix to the name of the element or as a superscript to its symbol, thus Uranium-235 is the name, and U^{235} (or $_{92}U^{235}$) the symbol of the Uranium isotope of atomic number 92 and mass number 235.

Positron: The positron is an elementary particle, identified as a positively charged electron. It is exactly identical with an electron in atomic weight (5.4862×10^{-4} a.m.u.) theoratical rest mass (9.1066×10^{-28} gram) and energy (0.515 Mev. $=8.18\times10^{-27}$erg) and its positive charge is equal to the numerical value of the negative charge of the electron

The position is an extremely short-lived particle, capable of existence only while in motion, as soon as it comes into the vicinity of an electron, it combines with the latter to form a photon, and conversely, high energy photon can produce electron-positron pair. Positrons can be observed in the radiation of certain unstable radioactive isotopes.

ENERGY AND RADIATION

MASS ENERGY EQUIVALENCE PRINCIPLE: This fundamental principle as announced by A. Einstein in 1905, is as follows: $E = mc^2$ (i.e. $m = \frac{E}{C^2}$)

where E is the energy, m is the mass, and C the speed of light in vacuum. From this equation it follows that mass and energy are interconvertible aspects of the same property, and when a body given up energy, it also loses mass, i.e. weight. This principle holds good in all cases, but in ordinary chemical or molecular processes the change in mass is too microscopically small to be measured or observed. In the case of nuclear energy, however, it is of an order sufficiently great to be measured.

$$E = mC^2,\ C = 2.998 \times 10^{10}\ \text{cms/sec}$$
$$E\ (\text{Ergs}) = m\ (\text{Grams}) \times (2.998 \times 10^{10})^2$$
$$= m\ (\text{Grams}) \times 8.99 \times 10^{20}.$$
$$1\ \text{calorie} = 4.184 \times 10^7\ \text{ergs therefore.}$$
$$E\ (\text{Calories}) = m\ (\text{grams}) \times 2.15 \times 10^{13}$$

When a positron and an electron annihilate one another, energy is produced which appears in the form of gamma rays (X-rays of shorter wavelength). Rest mass of the electron $= 9.11 \times 10^{-28}$ grams.

$$\text{Rest mass of the positron} = 9{,}11 \times 10^{23}\ \text{gram.}$$
$$E = 2.911 \times 10^{23} \times 8.99 \times 10^{20}$$
$$= 1.64 \times 10^6\ \text{erg.} = \mathbf{1.02\ Mev.}$$

Hence the total energy accompanying positron electron annihilation is 1.02 million electro *volts. If this energy is radiated in the form of X-rays, then its wave length will be

$$= 1.21 \times 10^{10} = 0.0121\ \text{Angstrom unit (A).}$$

*MASS-ENERGY CONVERSION FACTORS:

$$E = (\text{ergs})\ m\ (\text{atomic weight}) \times 1.49 \times 10^{-3}$$
$$E = (\text{Mev})\ m\ (\text{atomic weight}) \times 931.$$

NUCLEAR FISSION: Cockcroft and Walton in Cavendish Laboratory found that if a stream of protons at a relatively low velocity is directed against a film of alkali metal lithium, there emerge alpha particles (— particle — nucleus of helium atom having two protons and 2 neutrons fig. 5.).

Probably what happens is that a lithium nucleus takes up the proton and for an instant it contains 4 protons and four neutrons, making a mass of eight with a charge of four. The nucleus is so unstable that it breaks into two, forming two helium nuclei, each of mass 4 and charge 2.

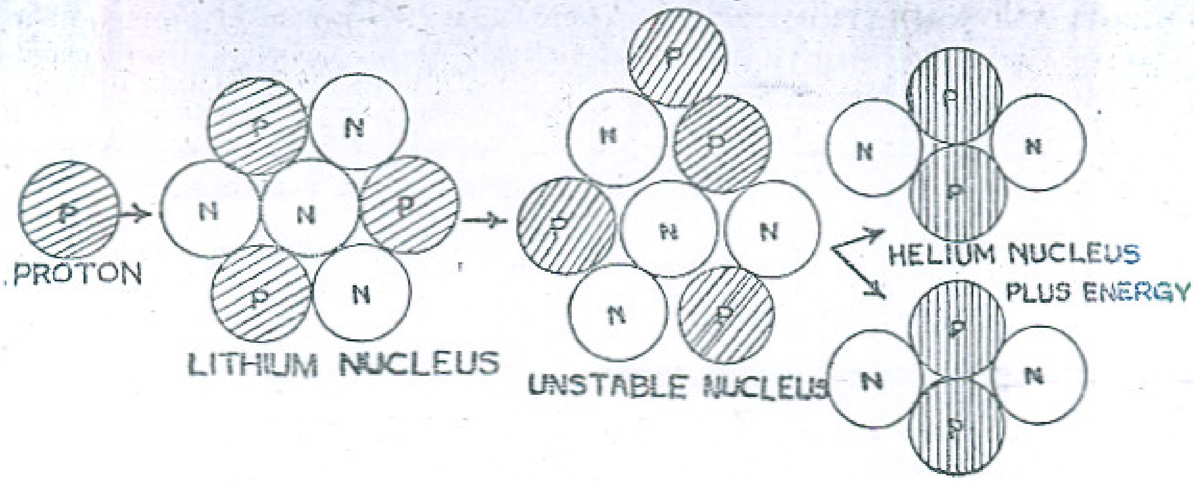
Actually the helium nuclei fly apart with great speed as if considerable energy were released in the readjustment of the unstable nucleus.

Therefore, the formation of 2 helium nuclei from Lithium and hydrogen has resulted in the loss of 0.0185 unit of mass. The lost mass actually weighs 3.07×10^{-26} grams. This multiplied by 931 gives the energy released by the reaction.

$$E = 0.0185 \times 931 = 17.2\ \text{Mev.}$$

The lithium-proton reaction results in the breaking of the lithium proton mass into two equal fragments—2 helium nuclei. In biology when a cell is divided to produce two equal daughter cells, the process is called fission. Byanalogy the breaking up of the nuclei may be called NUCLEAR FISSION.

When one neutron is absorbed by by Uranium — 235 the latter breaks into two to give Molybdenum (MO —95) and Lanthanum (La —139) with the release of lots of energy and with the release of neutrons. The released neutrons might them be absorbed by other uranium atoms, each of which would split into Mo^{96} and La^{139}. In this way



one might get not only a lot of energy as the result of fission, but one or several neutrons to keep the process going on as a chain reaction until all uranium was changed into Molybdenum and Lathanum.

Isotopic weight of Uranium-235	= 235.124
Mass of Neutron	= 1.00897.
Total mass	= 236.133
Isotopic weight of Mo-95	= 94.945
Isotopic weight of La-139	= 138.955
Mass of two neutrons	= 2×1.00897 =2.01794.
Total Mass after reaction.	= 235 918
Loss of Mass = 236.133-235.918	= 6.215 a.mu.

Energy equivalent of this mass released in fission $=0.215 \times 931 = 198$ Mev Therefore, one would calculate what would happen with a pound of U —235 pure. If a chain reaction could become established and all the atoms in a pound of U —235 be fissioned, the energy produced would be over 400 billion billion ergs, or in common units 12,000,000 Kilo-watt-hours.

If this energy were released quickly, say in afraction of a second, it would have the explosive force of about 10,000 tons of TNT. Clearly a new order of explosive force was possible.

If this energy were released slowly under control it would furnish an electric current that keeps 12 million 100 watt lamps going for 10 hours a day.

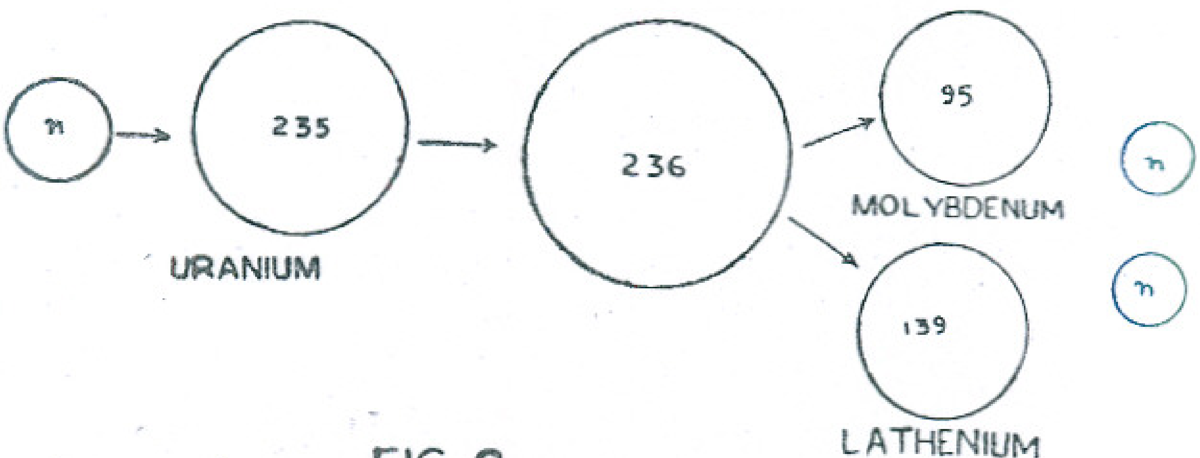


FIG 8

West Pakistan's Food and Irrigation Problems

by *Saleem-ud-Din Khawaja**

In an agricultural country like ours, irrigation development, food requirements and increase in population are inter-linked problems and need be studied together. A study of the area under different crops in our country in different year is very instructive. These figures are given for the former Punjab.

YEAR	WHEAT	RICE	COTTON	TOTAL FOOD AREA	TOTAL CROPS SOWN
1901-02	0.376	0.029	0.044	0.750	1 23
1911-12	0.578	0.024	0.116	0.935	1.28
1921-22	0.533	0.041	0.083	0.088	1 47
1931-32	0.472	0.036	0.116	0.930	1.30
1941-42	0.432	0.035	0.137	0.801	1.175
1950-51	0.391	0.044	0.091	0 738	1.005

It will be observed from the above table that in 1911-12 the area under wheat was the maximum after which it was declining until it had reached the figure 0.391 in 1950-51. It may be added that floods of September, 1950, caused incalculable damage to life and property and at the same time caused increase in the area under sailab irrigation but in spite of this, there had not been increase in acreage under wheat crop. Total area for food per head of population has also come down from a maximum of 1.088 acres achieved in 1921-22 to 0.738 acres recorded in 1950-51. If we consider the figures of total cropped area, it will be found that it continued to increase progresively to 1.47 acres in 1921-22 after which a systematic decline is noticeable. This decrease can be attributed to the increase in population. From the census figures we find that whereas population of ex-Punjab had increased from 94,72,372 in 1901 to 1,88,14,201 in 1951; the total area under crops increased from 1,40,65,946 acres to 189,22,053 acres only. The detail of produce being food (70,96,770), cotton (4,17,035), wheat (35,64,585) rice (2,73,330, in 1901 and food (1,40,65,946), cotton (17,15,405), wheat (73,53,201), rice (8,35,997) being in 1951. It may, however, be mentioned that during the period 1912 to 1940 and in 1946-47 there had been marked increase in irrigation and there had been considerable area under crop in 1951 as compared to that in 1901 but the various projects were just sufficient to cope with the increase in population. The population in fact

**O.S.D., Office of Chief Engineer, Irrigation, West Pakistan.*

has really doubled but there had not been corresponding in the area under crops. Density of population had increased from 156 in 1891 to 302 in 1951. According to Malthus Law of population "the population grows in geometric progression while food supply in Arithmatic progression." It will be apparent that this law holds good for our conditions. The rate of yearly increase of population has been 1.29% for the whole of Pakistan and the total area sown per head of population is 0.72 acres and area under food crops is still less at 0.59 acres.

SHORTAGE OF FOOD GRAIN IN PAKISTAN

In the United States of America, it has been estimated that for an emergency restricted diet, in which cereals are predominent, an area of 1.2 acres per head, is required for consumption in periods of emergency for poor people. It will, therefore be seen that keeping in view our comparatively small yields per acre, an area of not less than 1.2 acres per head is most essential. An average of three years for overall Pakistan, food production from 1949-50 to 1951-52 comes to be 1,23,58,000 tons which includes rice, wheat, maize, bajra, jawar and barley. Against this, at an average rate of eight chattaks per head per day the requirements for 76 million people comes to be about 1,23,84,000 tons, which shows there is a shortage of about 26,000 tons of food grains in the whole of Pakistan.

SUGAR REQUIREMENTS

The existing minimum annual requirement of sugar is about 1 lakh tons in western wing while actual production capacity is 50,000 tons only. It is, therefore, necessary to install more factories for crushing sugar-cane and to increase the area under this crop because the present area is just sufficient for the existing factories.

FRUIT

The minimum fruit requirement in a balanced diet is said to be 1½ chhattacks per head per day. The total requirements of fruit for West Pakistan come to be 28 million maunds against 10 million maunds available at present. It has been estimated that average yield of fruit per acre is about 69 maunds. This 18 million maunds will require about 2,60,000 acres of new area.

It will be observed that if acreage of food grains is increased in one year the yield does not increase substantially. The following example will illustrate the point:-

YEAR	Acreage for whole of Pakistan	Yield of Food Grains of All Kinds
1948-49	4,02,37,000	1,44,02,000 tons
1949-50	4,02,76,000	1,39,60,000 tons
1950-51	4,11,51,000	1,40,11,000 tons

LOW YIELD

It shows that there is something wrong with our rate of yield which is 30 to 40% of those attained in Japan and Egypt. Checking fall of yield is our another agricultural problem, which seems to be the result of worsening economic conditions of the peasants, their capacity to do work and refugee resettlement, etc. However this deficiency can be made up by improved methods of farming use of chemical manures and early settlement of refugees. There is another factor which is diminishing the agricultural produce, this is locally called "Thur". About 50,000 acres of land are affected by this menace yearly while about 25,000 acres are reclaimed in the same period.

With the increase in population at the annual rate quoted above we must be able to feed about 4 lakh mouths every year in western wing for which necessary increase in the area has to be provided.

The present area in million acres in West Pakistan is as under:-

Net area sown	Current fallow	Total cultivated area (1x2)	Other cultivated land excluding current fallows	Forests	Net available for cultivation	Area not reported	Part of ex-Baluchistan NWFP, Tribal area and desert etc.
28.21	10.82	39.03	18.99	2.38	23.34	83.74	112.07

Total area of West Pakistan thus comes to be 195.81 million acres or 3,10,596 square miles.

Having determined the population, its increase, the cultivated areas, the quantity of food available and requirements, the next step is to boost up our food grain area to meet the needs of the country. The rainfall in western wing varies from 5" to 35", therefore, we have to depend on our irrigation system. It is expected that when the projects in hand are fully developed then new irrigated areas will help to raise the economy of this province by increasing the produce of the food grains.

The additional area to be cropped when the new projects are completed will be in thousand acres as under:-

Thal 1,167: Taunsa 710; Ghulam Muhammad Barrage 1,413; Gudu 907; Makhi Dhand 150; Kurram Garhi 150; Warsak 120; and Nari Bolan 24.

There is imperative need to explore possibilities of small irrigation schemes in Quetta and Peshawar Irrigation Regions; and also to increase our water supplies for irrigation purposes. Explorations are already in hand to see the feasibilities to construct small dams on Indus and its tributaries. Daman tract in D. I. Khan is expected to irrigate about 3.3 lac of area. A lined channel of 2,300 cusecs from Kalabagh on its right side is proposed for D. I. Khan. There are also small schemes as Tank Zam River Flood control in D. I. Khan; Kohat Toi reservoir scheme; Swat river storage reservoir scheme; Gomel Zam Flood Control and Irrigation scheme which envisages the construction of a dam at Gulkatch Tributary. This supply will be used in conjuction with the water of Zhole distributary and will command an area of 75,000 acres in the hitherto undeveloped, Tribal territory. The Abbasia Canal extension scheme aims at developing about 274,000 acres of Crown waste land.

In Quetta region Nari Canal irrigates 17,500 acres, Pishin 5,000 acres and canals in Lohari; Jhal and Tamboo areas 50,000 acres. Springs and Karezes irrigate about 300,000 acres of land. At present about 600 Karezes are working. Thus this region which has an area of about one-third of whole of Pakistan, irrigation facilities are limited. To increase water yields the infiltration galleries and sections of Karezes will have to be lined with pervious or impervious materials as the case may be.

By 1960 about 2.5 million acres of new area will be brought under irrigation and 3.3 million acres more area will have an improved water supply or been reclaimed from salinity, etc. About 19.5 million acres of culturable land are irrigated by three rivers which rise in other country and can be threatened at any time. We shall have to make arrangements for water supplies to these areas to meet such a situation.

West Pakistan, therefore, is in need of more water to ease the situation created by ever increasing population. The reservoir sites offer only 25 M.A.F. supply while we require 100 M.A.F. reservoir capacity for future development. More investigations for water resources are needed to deal with the situation.

Hydraulic Silt Clearance From Canals

*by Asrar A. Qureshy**

A hydraulic canal dredge operates on the same principles as the famous hydraulic dredges that dug the Panama Canal and still maintain it. Solid material to be moved is cut loose and agitated by a rotating cutter head. The loose material and the water carrying it is sucked by a heavy duty dredge pump. The mixture is pumped through the discharge pipe to the desired fill or spoil areas. This "vacuum cleaner" action does a more complete job of clearing an area than any mechanical form of dredging yet devised. Digging, pumping and depositing the solids are done in one continuous operation.

A hydraulic canal dredge, therefore, consists of the following essential parts; (Fig. A):—

(1) **A multi-plate spiral cutter,** made of special analysis cast steel, requiring a minimum of maintenance, which cuts the solid material loose and agitates it.

(2) **A heavy duty dredging pump** which sucks the mixture of loose material and water.

(3) **A diesel engine** which drives the bredge pump through a direct driven speed reduction unit. Engine speed is controlled by remote throttle from operating stand.

(4) **A dredging ladder** which supports the suction pipe and cutter driver and is fabricated from heavy structural steel shaps.

(5) **Two forward spuds** (or front legs) to hold the dredge in place while digging is controlled from operating stand.

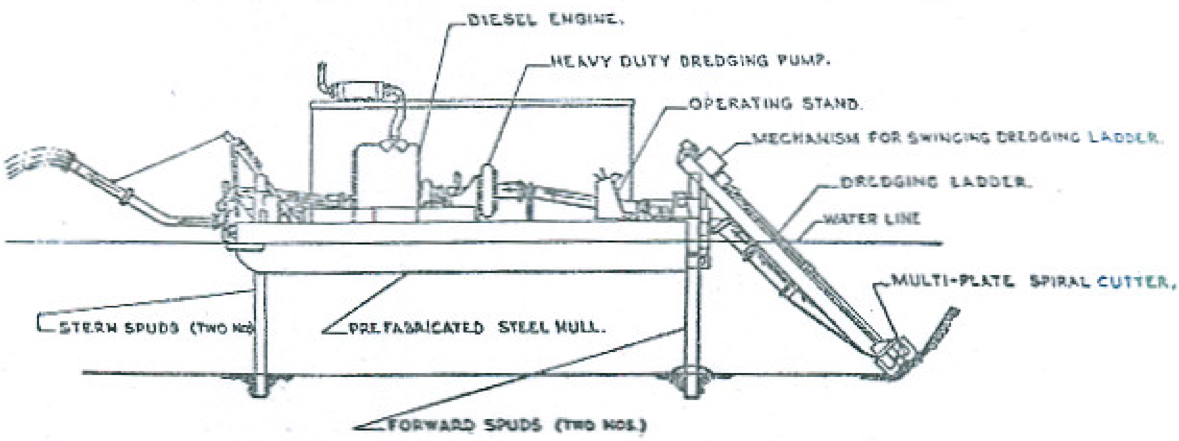


FIG. A. SHOWING IMPORTANT PARTS OF A HYDRAULIC CANAL DREDGE.

*Hony. Secretary, Institute of Engincers, Pakistan, Lahore Centre.

(6) **Stern spuds** (or hind legs) which provide forward and side motion of the dredge and are controlled from operating stand.

(7) **Operating stand** where centralized controls are located. One man controls the complete operation of the dredge.

(8) **Mechanism** for swinging, raising and lowering dredging ladder for digging.

(9) **A prefabricated steel hull** which carries and supports all the above parts. These hulls are strongly reinforced against heavy stresses frequently met in dredging and transportation.

SIZE AND PERFORMANCE

These canal dredges are available in four different sizes — 6", 8", 10" and 12" discharge pipe diameters. Even the 12" dredges need only 16 feet of working space, which is less than half that is needed by the conventional pipe-line dredge.

Performance specifications of the ELLICOTT DRAGON Model Canal Dredges are reproduced here for ready reference.

Performance Specification of
ELICOTT Dragon Model Canal Dredges

Size.	Rated output per hour pumping mud and silt through 25' pipe with 15' Elevation.	Standard Digging Depth "A" Fig. 1	Channel Clearance with Swinging Ladder.			Channel Clearance with ladder in Fixed Position
			At Water Level		At Maximum Digging Depth.	
			B. Fig. 2	C-Fig. 3	D-Fig. 1	
6'	70 cu. yds.	8'	13'	17.5'	15'	30'
8'	100 cu. yds.	8'	13'	17.5'	15'	30'
10'	150 cu. yds.	12'	16'	21'	17'	38'
12'	300 cu. yds.	12'	16'	21'	17'	38'

The smallest of the dredges — the 6" — dig 30 to 80 cu. yds. (810 cu. ft. to 2160 cu. ft.) per hour, depending on the type of material being moved. It can transport and deposit this material at the side of the channel or up to 200 ft. away. The large size canal dredges, naturally have correspondingly work capacities.

None of these dredges require larger tugs or other auxiliary craft. Nor do they require personnel on shore. This makes these dredges economical and fast to operate.

All the canal dredges are extremely versatile and very efficient. They can be carried on one low bed trailer without disassembly and can be lifted easily by one crane. They are at work all over the world—cutting and maintaining waterways, cleaning reservoirs, and on many other cleaning, widening and desilting operations.

SUMMARY OF SPECIAL FEATURES

Basic features of a hydraulic dredge can be summarised as follows:—

(1) **Hydraulic dredging:** Pumping a mixture of solids and water is the cheapest method of moving bound solids.

(2) **Self-floating:** Digs its own floatation in narrow channels or canal completely choked with sediment.

(3) **High work capacity:** Rugged construction of hull and machinery, plus continuous operation, mean little downtime, few delays to work.

(4) **Portable:** Can be back in operation quickly after arrival overland from previous job. Easy to transport.

(5) **Walking action:** No external source of power is needed during dredging operations. New four-spud system on canal dredges gives even greater stability and maneuverability.

It is high time that we in Pakistan also start using the modern hydraulic dredges alongwith our manual labour. Hydraulic dredging, in addition to being very economical, also permits silt clearance and widening in running water, whereas a closure is necessary otherwise.

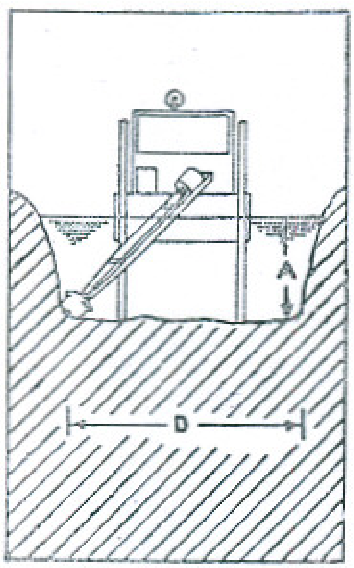


FIG. 1.

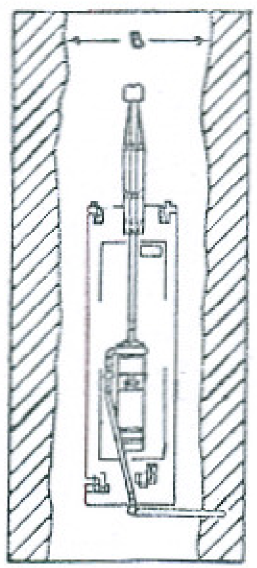


FIG. 2.

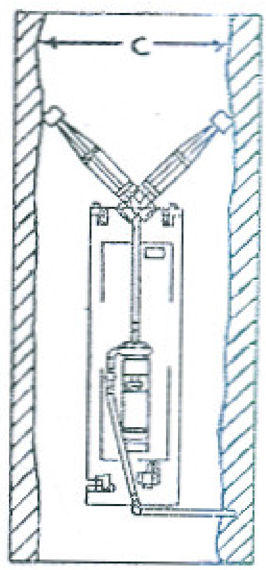


FIG 3

LAYING OF CONCRETE PIPES

*by Masud Ahmad**

THE problems of the storage and conveyance of water for the benefit of a civilization have fascinated the attention of the Civil and Hydraulic Engineer for centuries and the steady progress made in this direction is a story of ingenious exploitation and invention.

The limited space available does not permit to deal in any detail with even a single branch of the subject and as such in the lines that follow we shall confine our attention only to the most modern methods of laying the concrete pipe lines in open cuts for the conveyance of this primary necessity of life, *i.e.* the water. The subject has been dealt under the following heads:-.

1. Embedments in Stable Soils.
2. Embedments in unstable Soils.
3. Making of joints.

EMBEDMENTS IN STABLE SOILS

A uniform support throughout the length of the pipe is the basic requirement of a sound pipe line. To ensure this pipe line, the pipe line constructed through stable soils such as hard clay, sand, stone, etc., etc., are provided with a firm, but slightly yielding embedment.

If a pipe is placed directly over a non-yielding surface, it is subjected to a uniformly distributed lead on the upper half but the lower half rests on a concentrated support. This unbalanced condition causes serious trouble to pipe lines of all kinds and develops abnormal and unnecessary stresses on the pipe after the line is backfilled (Fig. I(a).

On the other hand when a pipe line is provided with a firm but slightly yielding foundation, the support reaction and the vertical loads are uniformly distributed on the pipe and thus equilibrium is established. (Fig I (b).

Accordingly such embedments are made by excavating the trench below the designed grade and laying the pipe on a 4 inches to 6 inches stablized layer

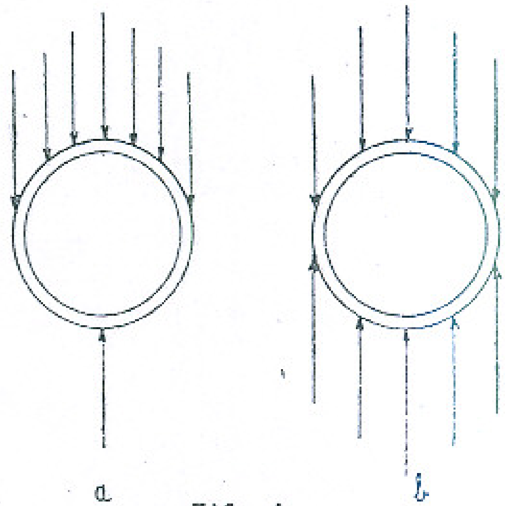


FIG: 1

of sand or of material from the trench excavation if suitable. The trench is then filled with the excavated material ensuring at least 2 ft. cushion above the top to provide a uniform and evenly distributed support for each pipe.

When pipes with bell and spigot joints are used, the bells are not allowed to rest on concrete support, *i.e.*, holes are

*Design Engineer, Irrigation Department.

excavated in the compacted embedment to receive the bells and provide a uniform support throughout the length.

Sometimes when the engineer wants to be positively certain that the line is provided with uniform support, concrete embedments are specified. Experience has, however, indicated that the concrete embedments have no structural advantage over compacted sand, grave or other suitable material unless the line is built on comparatively steep grade adjacent to streams, when there is a possibility that an embedment of sand, gravel or clay, etc., may be eroded due to the current of water travelling at moderate or high velocity under and outside the pipe lines, eventually causing settlement. When concrete is required to be employed as such the following method is adopted.

Foundation concrete of a dry consistancy is placed in the bottom of the trench (at least 3" thick for 12" dia. pipe) and the pipe is set to the established line and grade thereon. The remainder of the embedment is then made with concrete of a wet consistency, thus assuring a uniform support for the pipe line. (Fig. (2).

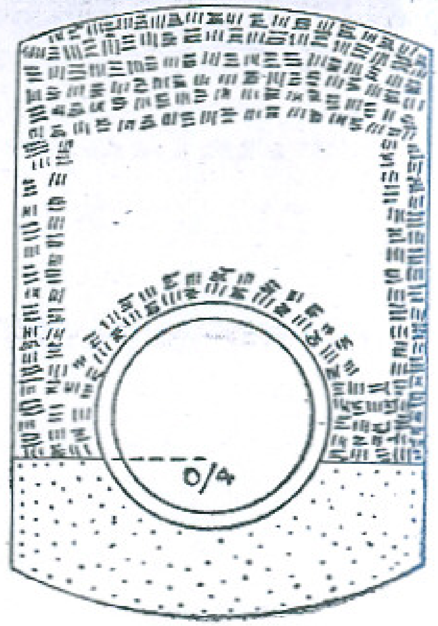


FIG. 2

EMBEDMENTS IN UNSTABLE SOILS

Pipe line constructed through unstable soil requires stable or semifloating foundations or embedments. Under the most extreme conditions a stable foundation can be provided with concrete or timber piling. However, for ordinary cases the following method employed in U.S.A. is quite suitable.

Tight sheeting is driven several feet below invert gradient to confine the muck. Muck is then removed to a depth of about 2 ft. below invert gradient and the trench bottom is stabilised with crushed stones. Planks are then laid at the bottom of the trench to the established line and grade. Wooden wedges between the pipe and the vertical sheeting are used to adjust the pipe to proper alignment and to hold it during construction. The tongue and groove joints of the pipe are then carefully made with portland cement mortar which is allowed to harden before the water table is permitted to rise above the top of the pipe. The line is then back filled with compacted sand to a foot or more above the pipe line and the remainder of the trench filled with the material excavated from the trench. (Fig. 3). All pipe lines at or below the water table are to be built on stabilised foundations.

MAKING OF JOINTS

The joints should be either bell and spigot or tongue and groove types. When the ball and spigot type of joint is used, the first pipe (downstream) is bedded to established line and grade with the bell (U|s). The interior surface of the bell is thoroughly cleaned with a wet brush and the lower portion filled with a stiff mortar of sufficient thickness to make the inner surface of the abutting sections flush and even. Lips at the joints are avoided as they materially reduce hydraulic capacity. The second pipe is then

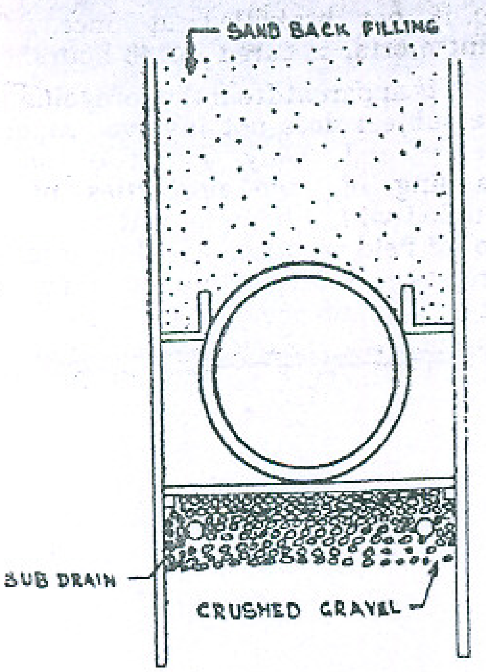


FIG: 3

thoroughly cleaned with a wet brush and uniformly matched into the bell so that the sections are closely fitted. The annular space in the bell is then filled with mortar and the inner of the pipe at the joint brushed smooth.

BELL AND SPIGOT

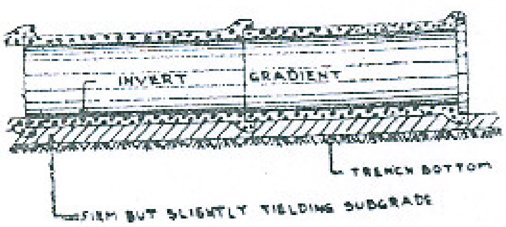


FIG: 4 a

TONGUE AND GROOVE TYPES

When the tongue and groove type of joint is used the first pipe downstream is bedded to established line and grade with the groove U|S. A shallow excavation is made underneath the pipe at the joint, this space is then filled with mortar which the end of the second pipe beds when laid. Then groove end of the first pipe is thoroughly cleaned with a wet brush and a layer of soft mortar applied to the lower half of the groove. The tongue end of the second pipe is also thoroughly cleaned with a wet brush and while in a horizontal position a layer of soft mortar is applied to the upper half of the tongue. The tongue end of the second pipe is than inserted into the groove end of the first pipe until the mortar is squeezed out on the interior and the exterior surfaces. The interior surface of the pipe at the joints is then brushed smooth. External band is also used with the tongue and groove joints and is made as under:-

TONGUE AND GROOVE

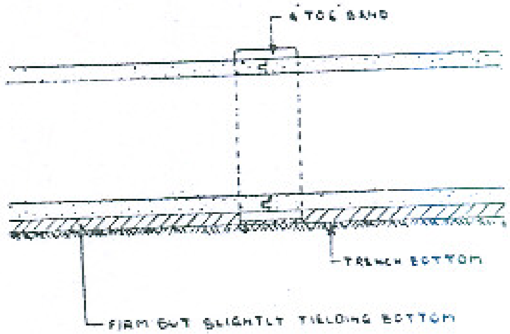


FIG. 4 b

The outer surface of the pipe at the joint is thoroughly cleaned with a wet brush to assure proper bond of the mortar with the concrete surface. This bonding operation is carried out four or five lengths behind the laying operation in order to prevent the movement of the pipe and a consequent loosening of the band. As the band is carried up around the lower half of the pipe, an earth support is provided to prevent its falling off. The band of the upper half of the pipe requires no supports. The band should have a thickness of at least one-half the thickness of the shell o. the pipe and a width of 4" to 6".

The portland cement mortar used for making joints in tongue and groove pipe is of two consistencies, one for the joints and other for the band. In bo cases the mortar consists of one portland cement to two of sand. The consistency of the joint mortar is such that it will adhere readily to the pipe and can be easily squeezed out at the joints. The bonding mortar is of a stiffer consistency than that used for the joints. The completed joints are immediately protected from air and sun with an initial covering of moist earth, sand or canvas, etc. if not backfilled at once. The joint mortar is cured for 48 hours.

It is apparent from the foregoing that the subject does not involve much of theory and only a little understanding of the properties of soil coupled with a simple but rigid control of field work can avoid unnecessary stresses in the pipe line and thus avert huge maintenance costs involved in stopping its subequent leakages and ultimate failures.

PAKISTAN'S FIVE-YEAR PLAN

*by Zahid Husain**

THE Planning Board has formulated a Five-Year Plan and it is hoped that it will be sanctioned by the Government, with such modifications as they consider necessary.

All institutions in the country and every individual will have to play a part to contribute to the fulfilment of the Plan. But its success will depend on the public administration. The major part of the Plan, that is, Rs. 800 crores out of the total of Rs. 1160 crores will be the direct responsibility of the Government. The fulfilment of the part assigned to the private sector will depend on the guidance, support and goodwill extended by the public services. Their efficiency and integrity, and their ability to create favourable conditions for public co-operation, will be the most important factors for the success of the Plan.

Public administration is the agency by which the Government discharges its responsibilities towards the people. In recent past, throughout the world, the scope of the duties of the State has been expanding and now extends fully to the protection and improvement of the standards of social and economic life. In backward countries these duties acquire added emphasis due to the urgency of formulating and executing comprehensive and integrated plans of development. A country desirous of rapid economic development and social betterment has to pay special and constant attention to the improvement and expansion of its administrative machinery.

**Chairman, Pakistan Planning Board.*

It is the considered judgment of the Planning Board based on the experience of other countries and our own that the shortcomings of public administration which include technical organisations will be a greater impediment to the fulfilment of Plans than the availability of financial resources. Even the scarcity of foreign exchange need not be such a severe limiting factor as the inadequacies of administration.

Under one of its terms of reference the Planning Board was required to recommend such changes in the administrative machinery as it considered necessary to ensure the implementation of the Plan.

The administrative system, methods and techniques need to be adapted to the objectives of State policy. The systems in vogue in our country are a legacy from the pre-partition colonial rule which in its turn inherited the administrative traditions relevant to the needs of the Middle Ages. The chief functions of the State were then concerned with the maintenance of law and order, collection of revenue and administration of justice.

The opening and maintaining of means of communications and transport was recognised as one of the functions of the State essential for law and order. Underlying these functions was the desire to maintain the status quo which meant peace. The industrial revolution had not made impact on the country and the duties of the State, outside communications and transport, were wholly non-technical. The technological progress of the country was extremely slow. The conditions thus were predominantly those of Agricultural Age.

The administration was general in character and its systems and techniques were so devised as to prevent decisions except after prolonged deliberations of a most meticulous character through a system of checks and cross checks, references and cross references.

These conditions and requirements gave birth to the secretariat system which is distinguished for several well known characteristics: domination by the general administrator to the almost complete exclusion of the technician; clerical supremacy in which knowledge of office business routine is mistaken for knowledge of men, affairs and technology, subservience to routine rules which became a substitute for understanding, common sense and vision, diffusion of responsibility so that no one is responsible for any decision; and a continuous tendency towards centralisation of power. This system served the alien ruler in preventing the risk of change. There were no social or economic programmes to be executed against schedule and delay was of no consequence. The top levels of the administrative hierarchy were sufficiently alert to act promptly and decisively in the event of a threat to peace.

Under freedom the conditions have been transformed. The State is irrevocably committed to the formulation and execution of ambitious plans of social and economic development. With rapid industrialisation the country has entered the Industrial Age, and the need of change is striking us in the head with its urgency and inevitability. The world is on the threshold of the Atomic Age and the pace of events is faster than at any time in human history.

The public administration is called upon to consider and give decisions on questions which involve the application of latest developments in all branches of human knowledge. It has to encourage, support and execute large programmes of the most intricate character. A recognition of the need of fundamental changes is overdue and, today, speed is the essence of administrative action. Large and extensive delegations of powers are needed to ensure execution of programmes. The avoidance of errors at the expense of movement is a luxury which can exact a high price. At the same time it is open to question whether the old system avoids errors.

Our systems have remained largely unchanged and sometimes one can see evidence of retrograde movement. The policies of the Government are unambiguous and clearly recognise that development and the promotion of people's welfare should form the core of the functions of the administration. The implications of this policy, however, are not yet fully reflected in the administrative organisations and their methods and techniques. Departments which permit the exercise of power carry greater prestige as against those which require the rendering of social service. Development departments are still rather minor members of the official hierarchy. The technician has not yet found the place and the status which he needs to formulate and execute programmes of development.

I will briefly mention some of the more important recommendations which the Planning Board has made.

First and foremost we consider that planning organisations at the Centre and in the provinces should be recognised as a permanent feature of the development machinery. They should be adequately equipped with technical and economic staffs and should be so located as to make an impact on the policies and actions of the Government.

The Development Commissioners who supervise the planning organisations in the provinces should have the rank of Chief or Additional Chief Secretary in order that development should rank in importance and prestige equally with law and order.

The District officers should be made responsible for rural development programmes in their areas and their personal merits for the purpose of promotion and advancement should be judged on the success achieved by them in fulfilling programmes entrusted to them. All representatives of development departments should be placed under the operational and supervisory control of the district officers. In this way all services in the district will be integrated in the cause of welfare programmes under the leadership of the district officers.

Technical heads of development departments should be introduced into the secretariat. This idea is likely to be viewed with disfavour on the supposed theory that policy and execution should be kept completely separate, policy being the responsibility of the secretariat and execution that of the technical departments.

This theory is impossible to apply in practice and leads to centralisation of power in the secretariat where the processing of proposals and programmes is not based on technical knowledge. A complete divorce of execution from policy does not contribute to speed in execution, and seriously restricts the ability of the technicians to make their full contribution.

The status and remuneration of scientists and technicians should be brought on a level with those of general administrative services in recognition of their importance and utility in the Industrial Age.

Local self-governing bodies are an important part of the administrative machinery of a democratic state. They have an important part to play in the provision of educational, health and other social services. Means must be found to improve their working, to increase their financial resources and to expand the scope of their activities. Local self-governing bodies should be encouraged and developed in the villages.

For undertakings of a multipurpose nature requiring co-ordination of a high degree among various departments of the Government, such as the development of areas newly brought under irrigation or of water and power resources, independent statutory bodies are the most efficient agencies. This will avoid delays, rigidity of approach and indifference to the desired results which seem to characterise Government departmental management.

A number of new organisations are needed by the country for performing important functions, such as social welfare council or boards, housing and settlement departments, authorities for industrial planning and development, university grants commissions, national council for apprenticeship training and many others.

It is not possible to mention all the recommendations which the Planning Board has made for improvements in the administrative machinery to enable it to perform its responsibilities in connection with development efficiently. I would however make a brief reference to the problem of integrity which must be regarded as one of the basic qualities of an efficient administrative machinery. It is not possible to dispute the view that the standards of integrity have deteriorated since independence. This view is shared by the public services themselves.

Under freedom the moral and social forces of the community alone will sustain high standards of integrity, but various suggestions have been made, for which no originality is claimed, to bring about an improvement. It must be emphasised that integrity should be interpreted in a wide sense. The lack of sincere and honest approach towards public business whether in matters of money, or appointments, postings and promotions or of distribution of contracts or other forms of patronage must lead to far reaching results extending over the whole area of public administration.

The people are entitled to expect high standards from the public services but lasting improvements will be possible when general standards of leadership rise to higher levels. This leadership is expected from the Cabinet, individual Ministers, other political leaders and senior administrators. We can expect that in course of time stable political conditions under the new constitution, along with development programmes in the towns and villages all over the country will pave the way for rapid improvement.

I will conclude by a reference to the saying of a Chinese sage that "if people's administration is not managed properly the people will perish." There are many examples in history of the truth of this saying.

SILT MOVEMENT IN CHANNELS

*Mian Fazal Karim Bhatti**

The phenomenon of silt movement in the irrigation Channels is a problem which has not yet been successfully explained. It is peculiar to the distributaries in the tail division of a large irrigation system. It has been noticed that some time, usually synchronizing with the change in season, particularly during the dry hot weather, some silt deposit appears and then after a short time gets picked up and washed away. The water surface level in the channel below this site suddenly rises from 0.5 to 1.0 or more depending on the size of the channel, even though no extra supply has been admitted at head. This results in numerous leakages and sometimes serious breaches in the reach thus effected.

CHANNELS ON WHICH "SILT MOVEMENT" GENERALLY TAKES PLACE.

It is an established fact that in rivers, the boulders are ground down gradually by stages to fine sand by process of rolling and impact as they are carried from the hills to the plains. With an entry into the canal at head, water carries a certain cargo of suspended or soluable stuff known as silt and a coarse stuff, generally rolled along the bed known as sand. The silt charge varies inversely as we proceed toward the tails and the silt size goes on decreasing by the process of attrition among the rolling sand particles dragged along the bed. There is a certain limit of abrasion below which the silt goes in suspension. It is on channels with such a silt grade and a lower silt charge that "Silt movements" generally take place. Such channels for obvious reasons, are the tail distributaries, or the tail reach of abranch itself in the tail division of a large irrigation system. It is generally believed that silt movements are intensified in the lower reaches of a canal, if there are a lot of raised created falls in the upper reach and also if a lot of silt exclusion has been resorted to in the case of distributary head regulators in the upper reach by constructing skimming platforms, silt vaces and other silt excluding devices.

SILT OR REACHES OF CHANNELS, WHERE SILT MOVEMENT GENERALLY OCCURES

Having come to know that silt movements generally take place on channels with a finer silt grade, it remains to be seen as to how and why it occurs at a certain place at a certain time particularly during the summer season. An answer to this question will be found in the description of the phenomenon of "Silt movement" as detailed hereinafter.

FUNDAMENTALS GOVERNING SURFACE EVAPORATION

Before an attempt is made to describe this phenomenon in detail it seems necessarw to acquaint ourselves with some of the fundamentals governing or emerginb from Surface evaporation.

These are:-

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1. The depth of water has nothing to do with surface evaporation but shallow water gets relatively more quickly heated than the deeper one, resulting in a relatively higher surface evaporation.

2. Where a small surface is exposed to evaporation in a calm air, a blanket of vapour soon forms above the water, which gradually reduces evaporation. If the air is next set in motion, there will be a decided increase in the rate of evaporation.

3. Vapour forms more rapidly than it can diffuse through the atmosphere due to the presence in air of colecules of dry gasses.

4. In calm weather surface evaporation continues so long as the temperature of water is higher than that of the atmosphere above.

THE PHENOMENON

Whenever, especially during the dry period of the summer season, water gets heated up, a considerable quantity is lost in evaporation. Simultaneously there is a slight increase in the velocity of water and reduction in the air pressure and surface friction. With this increase in velocity the water starts picking up more silt till it reaches a certain point on a channel, where it gets fully charged or in certain other cases is otherwise reduced to this stage by the addition of silt left in by the water lost in evaporation or through authorised and sometimes unauthorised withdrawals. This heated and silt saturated water continues flowing down till it passes through an air region with a relatively very low temperature or otherwise a very swift wind is suddenly set in motion thereby accelerating evaporation. It is here that water by undergoing a further loss of volume through evaporation or otherwise starts dropping its silt surcharge. Since the bed of a channel with a finer silt grade is generally even and smoother than that carrying a coarser silt, very few eddies are created and hence silt dropping takes place unobstructed with a greater intensity under full gravitational force. This silt dropping continues with the evaporation till the atmosphere above gets fully saturated and further evaporation stops.

The silt so dropped forms a sort of broad bed bar with the result that the water surface in the upper reach attains a flatter slope and a sort of pond is created. Since there is an over all effect of evaporation and a consequent reduction in the discharge in the reach above, the bar so formed is not affected by the flow of water during its formation, till the discharge is again made up or limiting velocity is reached. At this stage the silt selective behaviour of the water again increases and the silt so dropped is again broken, picked up, and washed away.

In emptying out the pond so created, and to regain its original steeper slope, water gushes out with an increased velocity thereby scouring deeper into the bed and thus causing an appreciable drop in the prevailing water levels in the reach immediately above with a corresponding rise in the water surface levels in the reach lower down. It is this excessive discharge so released with a very heavy silt charge which causes piling up in the channel lower down.

CONCLUSIONS

The following conclusions in brief may be derived from the discussions in the foregoing sections:

1. Silt movement generally takes place on the distributing channels with a finer silt grade, mostly in suspension.

2. Such movements are the direct result of the water getting silt-surcharged through any one or all of the following factors acting in conjunction and consequent dropping of silt surcharge:-

(i) Brisk evaporation.

(ii) A lower silt conduction by outlets and off-takes.

(iii) Unauthorised surface withdrawals.

REMEDIES

Since all this silt trouble on a channel results, besides other factors, into water getting silt surcharged through a brisk evaporation taking place as a result of an extreme variation in air and water temperature, hence the remedy should naturally lie in minimising these forces. But for the cost involved and working difficulties, a perfect solution would be to cover up all such channels or to arrange a complete silt ejection therefrom. From the practical point of view the best remedies would be:-

(a) To plant closely, preferably on berms, low and shady trees such as mesquit, etc., and in addition, to grow in belts, banana plants or some such other species on both sides of such channels. Such plantations will help to minimise evaporation, the former by shutting off the direct rays of the summer sun and the latter by increasing the humidity of atmosphere above.

(b) To supplement discharge atleast during the summer season, by pumping in clear and cold water by installing tube-wells at suitable intervals along such channels. Such a device is likely to prove multi-purposed in as much as it will lower the water table, keep down water temperature, retard silt saturation and finally help eliminating the so-called silt movement.